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EPA Superfund
Record of Decision:

GENERAL ELECTRIC CO/SHEPHERD FARM
EPA ID: NCD079044426
OU 01
EAST FLAT ROCK, NC
09/29/1995

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GENERAL ELECTRIC/SHEPHERD FARM
NATIONAL PRIORITIES LIST SITE
EAST FLAT ROCK, HENDERSON COUNTY
NORTH CAROLINA

RECORD OF DECISION

REGION IV
ATLANTA, GEORGIA
SEPTEMBER 1995

DECLARATION
FOR THE
RECORD OF DECISION

SITE NAME AND LOCATION

General Electric/Shepherd Farm Site
East Flat Rock, Henderson County, North Carolina

STATEMENT OF BASIS AND PURPOSE

This decisions document presents the selected remedial action for the General Electric/Shepherd Farm site in East Flat Rock, Henderson County, North Carolina, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the administrative record file for this Site.

The State of North Carolina concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedy addresses the principle threats posed by this Site. The major threats are the contaminated groundwater emanating from beneath the Site and the surficial contaminated soil.

The major components of the selected remedy include:

GROUNDWATER

- Extraction of groundwater from the GE and Shepherd Farm Subsites that is contaminated above Maximum Contaminant Levels or the North Carolina Groundwater Standards, whichever are more protective for each particular contaminant;
- Onsite treatment of the extracted groundwater via air stripping and carbon adsorption;
- In-situ bioremediation;
- Discharge of treated groundwater to Bat Fork Creek; and
- Continued analytical monitoring for contaminants in groundwater and surface water.

SOIL

- Shepherd Farm Subsite
- Excavation of the top foot of soils contaminated above the performance standards;
- Transportation of excavated soils to the dry sludge impoundment area on the GE property;
- Backfilling, grading, and revegatation of excavated areas.

GE Subsite

- Placement of a multi-layer cap on the areas where the soil is contaminated above the performance standards;
- Continuous maintenance of the cap;
- Usage restrictions on the capped areas.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Since this remedy may result in hazardous substances remaining onsite above health based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

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I. SITE NAME, LOCATION AND DESCRIPTION

A. Introduction

The General Electric/Shepherd Farm Site (hereinafter referred to as the "the Site") consists of three non-contiguous disposal areas in East Flat Rock, Henderson County, North Carolina. These disposal areas (subsites) are known as the GE property, the Shepherd Farm property, and the Seldon Clark property (see Figure 1).

B. Site Description

The GE subsite is located at the southeastern corner of Spartanburg Highway (U.S. 176) and Tabor Road (S.R. 1809) in East Flat Rock, Henderson County, North Carolina (see Figure 2). Geographically, the center of the subsite is located at approximately 35516'25" N latitude and 82524'10" W longitude according to the Hendersonville, North Carolina, USGS 7.5 minute topographic map. This slightly hilly, approximately 50-acre subsite is bounded on the west by Spartanburg Highway, on the north by Tabor Road, and on the east by Bat Fork Creek. The southern boundary is a fenceline south, east, and west of the recreational facility. General Electric also owns the plot of land located southwest of Spartanburg Highway, south of Bat Fork Creek, between the curved railroad tracks and the highway.

The Shepherd Farm subsite is located on Roper Road, approximately 1200 feet west of Spartanburg Highway and 2500 feet southwest of the GE subsite (see Figure 1). Geographically, the center of the subsite is located at 35516'10" N latitude and 82525'10" W longitude according to the Hendersonville, North Carolina, USGS 7.5 minute topographic map. This hilly, approximately 31-acre subsite is bounded on the north by Roper Road, on the north-northwest by the Seldon Hill Farm, and on the west by Bat Fork Creek (see Figure 3).

The Seldon Clark subsite is located at the northeastern corner of the Spartanburg Highway and Tabor Road intersection (see Figure 2-1). Geographically, the center of the subsite is located at 35516'35" N latitude and 82525'00" W longitude according to the Hendersonville, North Carolina, USGS 7.5 minute topographic map. This approximately 1-acre field is bounded on the west by Spartanburg Highway, on the south by Tabor Road, on the east by Jones Street and on the north by Second Ave (see Figure 4).

GE Subsite

The GE facility includes two major building structures: the manufacturing plant (350 feet by 700 feet) and the finished stock warehouse (700 feet by 300 feet). The buildings are separated by paved parking areas and grassy lawns. The two buildings are situated on a relatively flat hilltop, while the rest of the property is on a hillslope. A tall, barbed-wire, chain-link fence surrounds the entire property with the exception of the landspreading plots (described below) and the front of the facility where parking lots and manicured lawns exist. A guard is on duty at all times to keep unauthorized personnel out of the plant and facility grounds.

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East of the plant is Demonstration Street, a paved, relatively flat strip of land. Along this area, lighting fixture displays demonstrate the product line at GE. Several support facilities are located along or near Demonstration Street, including a fork lift shop, a fabricating shop, a reclamation yard, a boiler house, a chlorine building, a drum storage area, an outside vendor (OV) storage area, and other fixtures and structures such as water tanks and pumps, cryogenic tanks, gasoline pumps, and storage bins. A closed 0.5-acre landfill (Landfill A) is now paved over by this street.

East of Demonstration Street, beyond the paved lots, are approximately 26 acres of landspreading plots which are blanketed by vegetation and slope eastward downhill toward Bat Fork Creek. Southeast of Demonstration Street, beyond the drum storage area, is a dry, 3-acre, inactive sludge impoundment which currently has a thick cover of vegetation. Southeast of the finished stock warehouse is a large (5-acre), active, wastewater treatment pond. East of the large wastewater treatment pond is a small (1-acre), active, landfill area where construction debris and excavated soils have been deposited or stored. Southwest of the finished stock warehouse is a grassy lawn area which was also previously used as a landspreading plot.

The area south of Bat Fork Creek also belongs to GE and includes a small (1-acre), active, wastewater treatment pond, a recreational area with an adjacent playground which was also formerly used as a landspreading plot, and a closed 1-acre landfill (Landfill B), parts of which are currently paved over by a driveway leading to the recreation facility.

The unfenced Shepherd Farm property, formerly used for disposal of wastes from the GE facility, is currently a sloping wooded area used for residential purposes. Mr. Shepherd, the owner and operator of the now defunct disposal company, still maintains his residence on this property. In addition, a 22-acre manufactured homes community (Spring Haven) consisting of 125 lots (most with homes on them) and a community center are present on the southern portion of the subsite. A small unnamed intermittent creek runs through the middle of the subsite before discharging into Bat Fork Creek.

The unfenced Seldon Clark property, formerly used for landfilling of wastes from the GE facility, is presently a grass-covered field which slopes towards its eastern boundary, Jones Street. The only facility located on the property is a small run-down shack which was formerly used as a junk/antique shop.

C. DEMOGRAPHY

The Site is located in Henderson County, North Carolina, which had a 1990 census population of 69,285. The town of Hendersonville (the County Seat), the center of which is located approximately 3.5 miles northwest of the site, had a 1990 census population of about 7,300. The county population is about 79% white and 20% black, but in the GE Site vicinity, the distribution is about 96% white and 2% black.

Based upon a house count from USGS topographic maps, the population within 1 mile of the GE and Seldon Clark subsites (excluding the approximate 1,100 GE plant employees) is estimated to be 1,010. The nearest residence is adjacent to the southeast property boundary.

The Spring Haven Community at the Shepherd Farm subsite is a quality development of 90 homes of which approximately two-thirds are occupied year-round. Each unit has one or two persons and the average age is 67. Children are not permitted to live in the development but are present occasionally as visitors. Several of the Spring Haven units are located within the subsite disposal area while most of the other units are located within 500 feet. Four other residences on the south side of Roper Road (three at the Seldon Hill Farm and one at the Shepherd Farm) are also within 500 feet of the subsite disposal area. Based upon a house count from USGS topographic maps, the population within 1 mile of the Shepherd Farm property is estimated to be 1,044.

D. SURROUNDING LAND/WATER USE

The principal land use in the immediate vicinity of the GE and Seldon Clark subsites is residential. Some commercial and light industrial uses occur along Spartanburg Highway, however, and a large plant is on the north side of Tabor Road, across from the GE plant and east of the Seldon Clark property. A large power substation also adjoins the southeast boundary of the GE property. Open spaces surrounding the subsites are generally undeveloped or farmed land. Orchards are prominent to the northeast of the subsites.

The Shepherd Farm subsite is located a rural/agricultural area where land use principally residential, forest, or farmland. The nearest commercial and industrial activity is along Spartanburg Highway, about 2000 feet to the north and east (ATSDR, 1993).

Land is lightly developed along Bat Fork Creek, both upstream and downstream of the Site, and also along Mud Creek into which Bat Fork Creek discharges approximately 6 miles downstream of the GE subsite. Approximately 90% of the land along Bat Fork Creek is used for agriculture and the remaining 10% supports urbanized land uses.

Major natural resources in the area include surface waters (including some wetlands) and groundwater. While irrigation of agricultural lands along Bat Fork Creek is unlikely due to the relatively low volume of flow, residents have reportedly used the creek for watering gardens. In addition, some livestock are likely to obtain water from the stream.

While the steep banks, dense undergrowth, and narrow width of Bat Fork Creek may limit its utility for recreational fishing, some recreational fishing in this creek has been reported by residents. Bat Fork Creek flows into Mud Creek (also used for recreational fishing) which in turn flows into the French Broad River. The French Broad River is used for recreational fishing, swimming, and boating. However, there are no public water intakes along any portion of the surface waters downstream of the GE subsite (ATSDR, 1993).

The Hendersonville public water system obtains its raw water from three surface water intakes which are outside the watersheds possibly affected by the GE site. The GE facility has been connected to this public water system since it began operations. In addition, the majority of the residents within a 4-mile radius of the site are also connected to this system. Many homes and businesses near the site have relied on private wells (drilled in the shallow aquifer and averaging about 120 feet deep) for potable water in the past, and some still rely on private wells, but increasing numbers are being connected to the public system. The GE facility has provided bottled water to many residents in the vicinity of both the GE subsite and the Shepherd Farm subsite, and has paid for some connections to the public water system.

At the Shepherd Farm subsite, the Spring Haven development has always been connected to the public water system. The four residents at the Seldon Hill Farm and Shepherd Farm once relied on private wells for potable water, but are, now connected to the public water system.

E. TOPOGRAPHY

The GE Site is located within the Blue Ridge Physiographic Province of the Appalachian Highlands in the southern Appalachian Mountains. Topography in the area characterized as rugged with large hills and rounded mountains, and steep slopes and narrow valleys, but also with some flat areas in a few small valleys. The Asheville-Hendersonville area is characterized by a central plateau (the Asheville Plateau) with moderate relief of 500 to 600 feet, surrounded on all sides by mountains. Elevation of the Asheville Plateau is approximately 2200 feet above mean sea level (amsl) (NUS, 1991a).

The area around the Site consists of gently rolling hills with elevations at about 2100 to 2500 feet amsl. The slope at the GE subsite is generally to the southeast at about 2 percent. The slope at the Seldon Clark subsite is generally to the northeast at about 4 percent. The slope at the Shepherd Farm subsite is generally to the northwest at about 10 percent.

F. CLIMATE

The climate of the region is humid-continental. Average monthly temperatures range from 415 F in January to 775 F in July (Wallingford, 1989). Mean annual precipitation is 38 inches and mean annual lake evaporation is 34 inches. Mean maximum 24-hour rainfall is 3.7 inches (NUS, 1991a).

G. GEOLOGY

Most soils in the Blue Ridge Province are residual soils derived from weathering of the underlying bedrock. These soils may be shallow to deep and are typically clayey, although locally they may be coarse-grained. Other soils are derived from alluvium along the floodplains of major streams.

Based on several borings performed at the GE subsite, the soils at the site can generally be described as brown, micaceous, sandy silt near the surface, grading downward to loose firm, red-brown and dark brown, micaceous silty medium to coarse sand. The thickness of the residual soil at the GE subsite ranged from less than 1 foot to 88 feet. The boundary between soil and rock is a transition zone of very dense, partially weathered rock. The partially weathered rock (PWR) at the GE subsite is generally between 2 and 15 feet thick.

H. HYDROGEOLOGY

The shallow groundwater surface in the Blue Ridge Province generally occurs within the residual and alluvial soils. Water occurs in the pore spaces of these soils and the PWR, within the relict fractures of the PWR, and within the fractures and secondary openings of the underlying bedrock. Although the soil/PWR zone (hereinafter referred to as the "porous media" zone), and the bedrock zone (hereinafter referred to as the "fractured media" zone) are sometimes referred to as different aquifers, they actually comprise one shallow unconfined aquifer since the two zones are hydraulically connected as evidenced by the lack of both a confining zone and significant head difference between the two zones.

Groundwater flow in the Blue Ridge Province generally follows the topography. Recharge occurs from infiltration of precipitation on the hill and mountain slopes, while discharge generally occurs at the streams and springs. The groundwater surface at the site has been observed in monitor wells at depths ranging from 3 to 29 feet below ground surface.

I. HYDROLOGY

The surface water features potentially affected by the GE and Seldon Clark subsites include Bat Fork Creek and Mud Creek. The surface water features potentially affected by the Shepherd Farm subsite include the unnamed intermittent creek running through the subsite and into Bat Fork Creek and Mud Creek. These surface waters have been classified as "Class C" by the State, which is the basic water quality classification for all surface waters in the State of North Carolina, and protects freshwaters for secondary recreation, fishing, and aquatic life.

Runoff from all three subsites discharges into Bat Fork Creek. At the Shepherd Farm subsite, runoff also discharges into the unnamed tributary which then discharges into Bat Fork Creek approximately 400 feet to the northwest. At the GE facility, a natural spring which also discharges into Bat Fork Creek is located in a swampy area between Bat Fork Creek and the easternmost landspreading plots. In addition, GE has an NPDES permit to discharge treated industrial effluent into Bat Fork Creek from the GE facility surface impoundments.

Bat Fork Creek is a perennial surface water body which, from visual observation, appears to be about 10 feet wide and less than 1 foot deep at the site under normal flow conditions. The average gradient of Bat Fork Creek at the site is approximately 24 feet per mile. The stream lies within the French Broad River basin which is part of the Tennessee River Valley drainage system.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Site History

From 1955 to present, the GE facility has been used to develop, design, and manufacture complete high-intensity-discharge luminaire systems, which consists of the assembly of optical components, ballasts, mountings, and high mast lowering devices. The luminaire systems produced at the facility use several light sources including sodium and mercury. These lighting systems have many uses which include the illumination of roadways, sports arenas and related buildings and/or parking lots, indoor industrial and/or commercial complexes, and hazardous or dangerous location applications.

Operations at the facility are comprised of several manufacturing processes. Raw aluminum is smelted and die-cast into molds of light fixture housings. Strip aluminum is machined by a spin and die process into reflectors that are attached to the housings. These reflectors are finished in a metal finishing, polishing, or coating process to yield a highly machined, polished or satin surface, as desired.

From about 1955 until 1975, GE also manufactured "constant-current" transformers at this facility. These transformers were filled with PCB-containing oil, which were delivered to the facility in railroad tank cars (NUS, 1991a). GE has reported that PCBs are no longer used in their product line (ATSDR, 1993).

Prior to GE's purchase of the property in 1955, the GE subsite was used as an apple orchard.

Waste streams generated by GE's facility from the beginning of plant operations have included construction wastes, buffing compound, epoxy compound, phenolic residue, paint sludges, PCB capacitors, solvents, transformer oil, electrical insulators/capacitors, waste acids, dye cast mold released hydrocarbons, heavy petroleum greases, and varnish residues. These waste streams contain many VOCs, heavy metals, acids, and PCBs. Current waste streams include solvents, cadmium-contaminated baghouse dust, waste oils, and lab packs.

Landfill A received waste generated by the facility between 1955 and the 1960s. No information is available concerning the types of wastes, but it is assumed that the wastes are from the manufacturing process utilized during this time of operation. Landfill B is believed to have been operated during the 1970s. These unregulated practices of the 1950s and the 1960s were ceased by GE with the promulgation of state and federal legislation to control pollution to the environment during the 1970s. As these two former landfills have been partially paved over, there is no physical evidence of waste at the landfill locations.

Wastewater generated as a result of plant process, contains metals and solvents typically used during lighting system manufacture. GE implemented a wastewater treatment facility in the mid-1970s consisting of a lime treatment system to adjust the pH of treated waters prior to surface water discharge. They also constructed the two wastewater treatment ponds described previously. The unlined ponds were constructed of native clay and are approximately 10 feet deep. The larger pond has a controlled exit valve at its discharge point to the smaller pond.

As part of the waste treatment process, wet and dry sludges generated in the wastewater treatment facility were landspread on several plots surrounding the facility buildings between 1977 and 1980. These landspreading plots, totaling 26 acres, were delineated for disposal of wet and dry sludges that contained water, lime, and about 0.07 to 2.85 percent nickel typically used in plant processes.

From 1955 until 1975, GE also generated a substantial quantity of PCB wastes as a result of transformer production. Disposal of these wastes prior to 1980 is not well documented, but in 1984, PCB wastes were sent to Emelle, Alabama, for disposal.

Underground storage tanks (USTs) at eighteen locations have been used by GE in the past to store fuels, liquid supplies (paints and varnishes), and liquid wastes. All of these USTs are reported by GE to have been removed by March 1991, and all liquid storage is now performed in above ground storage tanks and drums.

From approximately 1957 to 1970, GE wastes were also intermittently deposited at the Shepherd Farm property where it was dumped, burned, and bulldozed in an approximate 3-acre area onsite. At the time of the dumping, the only other use of the property was for the Shepherd's residence. The Spring Haven community was later constructed over part of the dumping area. Most of the waste was reportedly deposited into an old dry pond or ravine approximately 800 feet southwest of the Shepherd residence. When the path leading to the ravine was iced, however, the waste was placed along the path. According to Mr. Shepherd, the waste consisted of cardboard, wood, office paper, and buffing compound. Occasionally, electrical "insulators" were taken to the site and broken to salvage copper. These might have been capacitors as insulators do not contain copper.

During the 1960s and early 1970s, GE wastes were also dumped in an approximate 0.3-acre ravine on the Seldon Clark property. GE reported that the property was used for the disposal of construction rubble only, but according to Mr. Clark, the ravine was also filled in with drums of aluminum paint and drums of cleaning fluid from dye-casting machinery. Old transformers are also reported to have been deposited in the ravine. The suspected disposal area located in the southwestern half of the property but there is presently no physical evidence of a landfill.

B. PREVIOUS INVESTIGATIONS

Several recent sampling investigations have been conducted at the site, especially at the GE facility. The quality of the data collected during the GE-conducted events, however, is unknown. These studies have included monitor well installation and groundwater sampling, soil sampling, surface water/sediment sampling, and offsite private well sampling.

Figure 5 shows the locations of all the permanent monitor wells installed at the GE subsite. Figure 6 shows the locations of the private wells sampled.

From 1986 through 1991, GE tasked Law Environmental to conduct sampling investigations of soil and groundwater around the GE plant site. In 1988 and 1989, EPA conducted Site Inspections and Investigations into the contamination at the GE facility, Shepherd Farm property, and the Seldon Clark property. Results of analysis revealed the presence of PCBs in soil and volatile organic compounds in the groundwater. A groundwater VOC (PCE) concentration map prepared by GE based on the results of these sampling events is presented in Figure 7.

The results indicate tetrachloroethene is the major contaminant present in groundwater beneath the site and, as discovered before, the greatest contaminant concentrations are present along the failed drain line. However, high concentrations of VOCs were also found along the railroad line southwest of the failed drain line area, indicating that a preferential flow path may be present along the railroad, or that another source of contamination is present in this area. One possible source identified in this investigation was an old drainage ditch which existed prior to construction of the drain line.

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C. PREVIOUS REMEDIATION EFFORTS

GE has conducted or prepared for several remediation and/or removal actions at the GE subsite. GE reports that all USTs and contaminated soils associated with these USTs have been removed. GE also reports that contaminated soil associated with the ruptured drain line have been removed. City water mains have been extended to all areas showing groundwater contamination based on private well sampling, and GE has paid for connections to these water mains and/or provided bottled water for all households so desiring such action. Figure 8 shows the areas near the GE property where residents were offered city water connections.

In 1990, GE also conducted a Phase IIIA Aquifer Characterization and Groundwater Treatment Study at the GE facility in preparation for performing groundwater remediation. In this study, a pilot groundwater recovery and treatment system was designed and installed at the GE subsite. The system consisted of four groundwater recovery wells (RW-1 through RW-4), a 10,000-gallon equalization tank, an air stripping tower, and associated piping and pumps with discharge going to Bat Fork Creek. Seven observation wells (MW-38 through MW-44) were also constructed for measuring water levels during an aquifer performance test. This system is still in place.

GE is currently testing a system whereby their process wastewater is discharge to the publicly owned treatment works (POTW) instead of to Bat Fork Creek through the wastewater treatment ponds.

D. SITE REGULATORY ACTIONS

The GE facility filed Part A of a hazardous waste permit for storage in 1980 under the Resource Conservation and Recovery Act (RCRA). In March 1982, GE petitioned to have its F006 electroplating sludge delisted as a hazardous waste. By April 1982, EPA issued a preliminary decision to declare the F006 waste as nonhazardous. The state of North Carolina accepted the petition and delisted F006 waste in October 1982. In 1984, GE elected to dispose of accumulated wastes offsite and therefore withdrew the Part A hazardous waste permit application and related interim status. On September 19, 1988, EPA formally recognized the state-approved delisting of F006 electroplating sludge as a hazardous waste.

GE has an NPDES permit for the discharge of treated effluent into Bat Fork Creek which became effective on May 1, 1989. GE also has an air permit issued on February 25, 1988, to operate several air emission sources or clean air devices.

After the EPA Screening Site Inspections and Listing Site Inspections described above were completed, the GE Shepherd Farm, and Seldon Clark properties were proposed for inclusion on the

NPL on February 7, 1992, as the "General Electric/Shepherd Farm Site". The site was finalized on the NPL in December 1994.

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EPA sent a notice letter to General Electric in July 1993 offering the opportunity to conduct the RI/FS. The notice letter also informed the PRP of its potential liability for past and future site costs. On January 4, 1994, EPA sent notice/request for access letters to Mr. Wayne Dickason, Mr. Lawrence Ward, and Mr. Shepherd. Ge was also sent a request for access letter.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Pursuant to CERCLA Sections 113(k)(2)(B)(i-v) and 117, the RI/FS Report and the Proposed Plan for the GE/Shepherd Farm Site were released to the public for comment on July 24, 1995. These documents were made available to the public in the administrative record located in an information repository maintained at the EPA Docket Room in Region IV and at the Henderson County Public Library in Hendersonville, North Carolina.

The notice of the availability of these documents was published in the Henderson Times News and the Asheville Citizen on July 24, 1995. A public comment period on the documents was held from July 24, 1995 to September 22, 1995. A copy of the notice was mailed to the site mailing list which contains names of community members and interested parties. In addition, a public meeting was held on August 3, 1995. At this meeting, representatives from EPA answered questions about the site and the remedial alternatives under consideration. Meetings with city and county officials were also held.

Other community relations activities included:

- Established an information repository
- Prepared an extensive mailing list
- Developed a community relations plan
- Issuance of a Fact Sheet on the RI/FS process in August 1994.
- Conducted a Superfund Workshop for the public in September l994.
- Issuance of a Fact Sheet on the RI results in June 1995.
- Issuance of a Fact Sheet on the Proposed Plan in July 1995.

IV. SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

As with many Superfund Sites, the GE/Shepherd Farm Site is very complex. However, all aspects of the cleanup will be addressed concurrently and the site has not been divided into phases or "operable units".

This ROD will present a final remedial action for the entire site.

V. SUMMARY OF SITE CHARACTERISTICS

During the Remedial Investigation, surface and subsurface soil, sediment and surface water samples were collected, temporary monitor wells were installed and sampled and permanent monitor and potable wells were sampled. For more details about sample results, please refer to the Remedial Investigation Report.

A. Soil Sampling

Thirty four surface samples and 41 subsurface soil samples were collected during this investigation. The sampling results will be summarized by each subsite.

GE Subsite

Twenty surface soil samples and 21 subsurface soil samples were collected from the landspreading areas, along the drain line and former ditch, along the railroad track and from the present and former landfills. Also, one replicate and two co-located samples were collected.

Landspreading Areas

Twenty four samples collected from 11 locations in landspreading areas A, B, C and D. The locations are indicated on Figure 9.

A single volatile compound was detected in the landspreading areas. The presumptive evidence of acetone was detected in samples 4-SLA, 4-SLB and 11-SLB at concentrations of 18N ug/kg, 17N ug/kg and 17N ug/kg, respectively.

PCB's were detected in one sample. Sample 11-SLA, the surface soil sample from landspreading area D, contained 60 ug/kg of PCB-1260. Pesticides were detected in all of the surface soil samples collected from the land spreading areas, except sample 11-SLA. Among these were dieldrin, 4,4'-DDT, 4-4'-DDE, and toxaphene.

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A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

Landfills

Three landfills, designated A, B and C, exist on site. Eight samples were collected from six locations in the three landfills. One grab surface soil and 2 grab subsurface soil samples were collected from landfill A. One composite surface and one grab subsurface soil sample were collected from landfill B and from landfill C.

Samples 13-SLA and 13-SLC collected from landfill A contained volatile organic compounds. Sample 13-SLA contained 27 ug/kg of 1,2-dichloroethene, 21 ug/kg of chlorobenzene and 23N ug/kg of acetone. Sample 13-SLC contained 16,000 ug/kg of tetrachloroethene, 1,600J ug/kg of ethyl benzene and 4,400 ug/kg of xylenes. Samples collected from landfills B and C contained no detectable volatile organic compounds.

Sample 18-SLA, landfill C, contained 180J ug/kg of fluoranthene, 130J ug/kg of pyrene, 90JN of pentachlorobiphenyl. Sample 18-SLB contained naphthalene, acenaphthene, dibenzofuran, flourene, phenanthrene fluoranthene, pyrene, benzo(A)anthracene, chrysene, benzo(B and/or K)fluoranthene, benzo-A-pyrene, indeno(1,2,3-CD) pyrene, dibenzo(A,H)anthracene, benzo(GHI)perylene and carbazole at concentrations up to 1,700J ug/kg.

Pesticides were not detected in any of the landfill samples. PCB's were detected in all the landfill samples. PCB-1242 was detected in sample 12-SLA, landfill B, at a concentration of 22,000C ug/kg. PCB-1254 was detected in all the samples at concentrations up to 36,000C ug/kg. PCB-1248 was detected in samples 512-SLA and 12-SLB, landfill B, and 18-SLA, landfill C, at concentrations up to 9,700C ug/kg. PCB-1260 was detected in all the samples at concentrations up to 120,000C ug/kg in samples 13-SLC, landfill A.

A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

Drain Line/Former Ditch

Four soil samples were collected from two locations beneath the drain line/former ditch. Location 14 was off the east corner of the main plant and location 15 was due west of the OV Stores building.

The presumptive evidence of a single volatile organic compound, acetone, was detected in sample 15-SLB.

Pesticides not detected in any of the samples. Sample 14-SLA and 14-SLB contained PCB-1254 at concentrations of 240 ug/kg and 160 ug/kg, PCB 1248 at concentrations of 150 ug/kg and 96 ug/kg, and PCB-1260 at concentrations of 540 ug/kg and 370 ug/kg, respectively. Sample 15-SLA contained PCB-1260 at a concentration of 64 ug/kg. Sample 15-SLB contained no detectable PCB's.

A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

Railroad Track

Two subsurface soil samples were collected along the railroad track. Location 16 was off the east corner of the main plant and location 17 was west of the warehouse building. The samples were collected just below the railroad gravel bed.

No volatile organic compounds were detected.

Pesticides were not detected in either of the samples. Sample 16-SLB contained PCB-1254 at a concentration of 53 ug/kg and PCB 1248 at a concentration of 46 ug/kg. Sample 17-SLB contained PCB-1260 at concentration of 58 ug/kg.

A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

Underground Storage Tank Locations

Three subsurface soil samples (samples 19, 20 and 22) were collected from locations near the former underground storage tank locations.

No volatile organic compounds were detected. Sample 20-SLD contained 1,000JN ug/kg of hexadecanoic acid and one unidentified compound. Samples 19-SLA and 22-SLD contained no detectable extractable organic compounds.

Sample 19-SLA contained 6.0 ug/kg of dieldrin, 25 ug/kg of 4,4'-DDT and 21 ug/kg of 4,4'-DDE. Pesticides were not detected in samples 20-SLD or 22-SLD. PCB's were not detected in any of the samples.

A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

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Seldon Clark Subsite

Soil borings were drilled at three locations, as indicated on Figure 10. Locations 30 and 31 were in the fill area on the Seldon Clark property and location 32 is west across Spartanburg Highway.

Sample 31-SLE (12-14 feet BLS) collected from the fill material contained acetone, methyl ethyl ketone, 1,2-dichloroethene and methyl hexanone at concentrations of 160 ug/kg, 190 ug/kg, 4J ug/kg and 30JN ug/kg, respectively. Samples 30-SLF (30-32 feet BLS) and 31-SLF (38-40 feet BLS), collected from native soil beneath the fill material, contained no detectable volatile organic compounds.

Pesticides were detected in samples 31-SLE, 32-SLB and 32-SLC. Sample 31-SLE contained 4,4'-DDT, 4,4'-DDE and 4,4'--DDD at concentrations of 11 ug/kg, 15 ug/kg and 76 ug/kg, respectively. Sample 32-SLB contained 4,4'-DDD, gamma-chlordane and alpha-chlordane at concentrations of 18 ug/kg, 15 ug/kg and 15 ug/kg, respectively. Sample 32-SLC contained 4.3 ug/kg of 4,4'-DDT, 8.8 ug/kg of 4,4'-DDE and 3.3J ug/kg of 4,4'-DDD.

PCB's were detected in two samples. Sample 32-SLA contained 220 ug/kg of PCB-1254, 420 ug/kg of PCB-1248 and 36 ug/kg of PCB-1260. Sample 32-SLB contained 86 ug/kg of PCB-1254.

A variety of metals was detected in the soil samples including: barium, chromium, copper, lead, zinc, mercury and manganese.

Shepherd Farm Subsite

Thirteen composite surface soil samples and 15 subsurface grab samples were collected from the Shepherd Farm property. The locations are indicated on Figure 11.

Eight surface and eight subsurface samples were collected from yards in the Spring Haven development. These locations are designated 50 through 55. The three samples collected from location 50 are considered control samples for the study. The fill area located behind and west of the Shepherd house and north of the Spring Haven development was divided into five areas. These locations are designated 56 through 60. One composite surface soil sample and a grab subsurface soil sample were collected from the center of each area at a depth of three feet to four feet BLS. Also, grab subsurface soil samples were collected from locations 57 and 59 at a depth of six feet to eight feet BLS.

Volatile organic compounds were detected in two samples. Sample 53-SLB contained 6J ug/kg of tetrachloroethene and 2J ug/kg of xylenes. Sample 56-SLA contained 2J ug/kg of tetrachloroethene.

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Extractable organic compounds were detected in eight surface soil samples and one subsurface soil sample.

Lindane was detected in sample 56-SLA at a concentration of 110 ug/kg. 4,4'-DDT was detected in samples 55-SLA, 55-SLB and 57-SLB at concentrations ranging up to 130 ug/kg. 4,4'DDE was detected in samples 55-SLB and 60-SLA at concentrations up to 130 ug/kg.

PCB's were detected in nine surface soil samples and three subsurface soil samples. Concentrations of total PCB's which exceeded 5,000 ug/kg were detected in samples 53-SLA, 56-SLA, 57-SLA and 58-SLA. Total PCB's concentrations which exceeded 1,000 ug/kg (but less than

5,000 ug/kg) were detected in samples 51-SLA, 51-SLB, 54-SLA and 60-SLA.

A variety of metals was detected in the soil samples including barium, chromium, copper, lead, zinc, mercury and manganese.

Sample 59-SLC was analyzed for eleven TCLP metals including silver, arsenic, barium, cadmium, chromium, lead, selenium, nickel, antimony, beryllium and thallium. Barium, the only contaminant detected, was found at 0.39 mg/l, which is below the TC Rule regulatory level of 100 mg/l.

B. Surface Water and Sediment Sampling

Thirteen surface water and sediment sample were collected from 12 locations during this investigation. Six samples, locations one through six, were collected from the GE property. Location 4 is a spring which flows into the adjacent creek. One sample was collected from the Seldon Clark property, location 30; and six samples were collected from the Shepherd Farm property, locations 50 through 54. Sample location 452 is a duplicate of sample location 52. The locations are indicated on Figures 12, 13 and 14, respectively.

Surface Water

Tetrachloroethene was detected in all six samples collected from the GE property and from samples 51-SW and 54-SW. The concentrations ranged between 0.53 ug/l and 3.5 ug/l. Sample 4-SW contained 6-8ug/l of cis-1,2-dichloroethene, 0.71J ug/l of 1,1,1-trichloroethane and 1.9J ug/l of trichloroethene. Sample 6-SW contained 7.4J ug/l of carbon disulfide. Samples 52-SW and 452-SW contained 3.0J and 3.2J ug/l of toluene.

No pesticides or PCB's were detected in the surface water samples.

Metals were detected in all of the surface water samples. The SMCL of 50-200 ug/l of aluminum was exceeded in all the samples collected. The SMCL of 0.3 mg/l of iron was exceeded in all the samples collected. The SMCL of 50 ug/l of manganese was exceeded in samples 2-SW, 3-SW, 4-SW, 5-SW, 6-SW and 30-SW.

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<IMG SRC 0495255N>
<IMG SRC 04952550>

Sediment

No volatile organic compounds were detected in the sediment samples. Extractable organic compounds were detected in eight sediment samples. Sample 30-SD contained phenanthrene, fluoranthene, pyrene, chrysene, benzo(B and/or K)fluoranthene, benzo-A-pyrene, indeno(1,2,3-CD) pyrene, dibenzo(A,H)anthracene and benzo(GHI)perylene. The concentrations ranged between 70J ug/kg and 150J ug/kg.

Samples 1-SD and 54-SD contained 4,4'-DDT at concentrations of 6.2 ug/kg and 5.0N ug/kg. Sample 2-SD contained 7.8 ug/kg of 4,4-'DDE and 5.6 ug/kg of endrin aldehyde.

Six samples contained PCB's. PCB-1248 was detected in samples 2-SD, 3-SD, 5-SD, 6-SD and 51-SD. The concentrations ranged between 54 ug/kg and 430 ug/kg. Sample 6-SD also contained 85 ug/kg of PCB-1254 and 34J ug/kg of PCB-1260. Sample 30-SD contained 49 ug/kg of PCB-1254.

A variety of metals was detected in the sediment samples including barium, chromium, copper, lead, zinc, and manganese. No elevated concentrations were detected.

C.   Temporary Monitor Well Installation and Sampling

Nine temporary wells were installed at the locations specified on Figures 15, 16, and 17. Sample 551-TW is duplicate of sample 51-TW. Location 50 is considered background for the site.

Volatile organic compounds were detected in six samples from five locations. Sample 2-TW contained 0.59J ug/l of 1,2-dichlorobenzene, 0.80J ug/l of 1,2,4-trichlorobenzene and 0.71.J ug/l of 1,2,3-trichlorobenzene. Sample 30-TW contained 0.067AJ ug/l of p-isopropyltoluene. Sample 50-TW contained l.1J ug/l of chloroform. Sample 51-TW contained 1.1J ug/l of vinyl chloride, 1.2J ug/l of cis-1,2-dichloroethene, 0.98J ug/l of trichloroethene and 29 ug/l of tetrachloroethene. Sample 53-TW contained 32 ug/l of tetrachloroethene.

Extractable organic compounds were detected in one sample. No pesticides or PCB's were detected in the temporary well samples.

Metals were detected in all of the temporary well samples. Sample 30-TW contained 0.28 ug/l of mercury. The MCL for mercury is 21 ug/l.

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<IMG SRC 0495255Q>
<IMG SRC 0495255R>

D.   On Site Permanent Monitor Well Sampling

Twenty four of the existing permanent monitor wells located on the GE property were sampled. Figure 18 indicates their locations.

Volatile organic compounds were detected in 21 of the 24 wells sampled. To facilitate the data presentation and discussion, the compounds cis-1,2-dichloroethene, trichloroethene and tetrachloroethene were chosen as indicator compounds. These compounds were detected at the greatest frequency in the wells. Cis-1,2-dichloroethene was detected in 18 wells at concentrations between 0.72J ug/l in well MW-22A to 380J ug/l in well MW-11. Trichloroethene was detected in 16 wells at concentrations between 0.93J ug/l in well 22A-MW to 130 ug/l in well 14-MW. Tetrachloroethene was detected in 20 wells at concentrations between 1.5J ug/l in well 21-MW and 1,600 ug/l in well 11-MW. Concentration isopleth maps for these compounds were developed using an exponential kriging algorithm and Golden Software's SURFER modeling program. These maps visually delineate the horizontal and vertical extent of contamination in the ground water under the site.

The results are presented as Figures 19, 20, and 21.

As indicated on the figures, the area with the highest contamination lies along the drain line/former ditch in the vicinity of wells NW-11, MW-12, MW-12A and MW-12B. The concentration gradient drops gradually toward the northeast, which is the direction of ground water flow, and more abruptly to the northwest and southeast.

Monitor well MW-14 contained high concentrations of all three compounds. This well is east-northeast of the former leaking underground storage tank located between the railroad track and the northwest side of the warehouse.

Two individual compounds detected which merit discussion are benzene and vinyl chloride. Benzene was detected in well 19-MW at a concentration of 2.7J ug/l and in well 38-MW at a concentration of 0.52J ug/l. Vinyl chloride was detected in wells 4-MW, 14B-MW and 38-MW at concentrations of 2.8J ug/l, 0.69AJ ug/l and 2.4J ug/l, respectively. Vinyl chloride is a degradation product of tetrachloroethene.

Extractable organic compounds were detected in five samples. Sample 11-MW contained 1.8J ug/l of 2-methyl naphthalene, 3.2J ug/l of 1,2,4-trichlorobenzene, 4.7J ug/l of naphthalene and 3.3J ug/l of 2,4-dinitrophenol. Sample 12-MW contained 5.1J ug/l of 2-methyl naphthalene, 3.0J ug/l of 1,2-4-trichlorobenzene, 37J ug/l of naphthalene, 2.3J ug/l of dibenzofuran, 1.1J ug/l of fluorene, 1.3J ug/l of phenanthrene. Sample 12A-MW contained 3.2J ug/l of 1,2,4-trichlorobenzene, 2.8J ug/l of naphthalene.

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<IMG SRC 0495255T>
<IMG SRC 0495255U>
<IMG SRC 0495255V>

Metals were detected in all of the monitor well samples. Primary MCL's for barium and beryllium were exceeded in sample 38-MW, which contained 4,000 ug/l of barium and 15 ug/l of beryllium. The MCL's are 2,000 ug/l and 4 ug/l, respectively. Manganese was detected in 21 samples at concentrations ranging between 4.9 ug/l in sample 32-MW to 5,000 ug/l in sample 38-MW. Thirteen samples contained concentrations above the secondary MCL of 50 ug/l. Iron was detected in 15 samples. The secondary MCL for iron of 300 ug/l was exceeded in eight samples. Mercury was detected in samples 4-MW, 12-MW, 14-MW and 35-MW, at a concentrations ranging between of 0.22 ug/l and 0.62 ug/l. The MCL for mercury is 2 ug/l.

E. Potable Well Sampling

Eleven potable wells were sampled during this investigation. Figure 22 indicates the well locations.

Volatile organic compounds were detected in two samples. Sample 83-P contained 1.1J ug/l of tetrachloroethene and sample 91-PW contained 0.58J ug/l of 1,1,1-trichloroethane. Neither of these concentrations are above their respective MCL's. No extractable organic compounds were detected in the potable well samples. No pesticides or PCB's were detected in the potable well samples.

A variety of metals was detected in all of the potable well samples. Samples 73-PW and 91-PW contained 24 ug/l and 19 ug/l of lead, respectively. Sample 91-PW contained 550 ug/l of zinc. The SMCL for zinc is 500 ug/l. Six samples contained aluminum. Samples 83-PW, 15-PW and 43-PW were above 200 ug/l. Samples 73-PW and 91-PW were above 50 ug/l. The SMCL for aluminum is 50-200 ug/l. The SMCL of 50 ug/l for manganese was exceeded in samples 2-PW, 15-PW, 6-PW and 43-PW. The SMCL of 0.3 mg/l for iron was exceeded in samples 83-PW, 15-PW, and 6-PW.

F. Well Survey

In July and August, 1994, EPA mailed out 990 private well/water use surveys to residents living within one mile radius of the GE plant subsite. Approximately 109 or 11% were returned by the post office for various reasons (person moved, no forwarding address, post office box closed, etc.) Of the remaining 881 who received the survey, only 309 residents, or 35% of residents who received the survey, completed the questionnaire, and returned it to EPA. Of those, 224 or 72.5% were currently receiving city water. Eighty five of those responding to the survey or 27.5% indicated that they were currently using their well for drinking water or other household purposes.

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Table 1   Summary of results of toxicity tests on surface water samples collected from streams near General Electric, East Flat Rock, NC. November 1994.

Sample ID #	Sampling Location	Ceriodaphnia 7 day Chronic Adult Survival	Ceriodaphnia 7 day Chronic Average # Young	Algae Growth (mean cell density in fluorometer units	Microtox LC50-1 (% sample)
GE-101-SW	Background for Unnamed Tributary	10	23.4	3.21	>100
GE-102-SW	Unnamed Tributary	10	24.6	2.99	>100
GE-103-SW	Bat Fork Creek - Spring Haven Trailer Park	10	37.2	4.08	>100
GE-104-SW	Bat Fork Creek - Shepherd Farm	9	37.7	4.01	>100
GE-105-SW	Bat Fork Creek - Background for GE Site	10	31.2	3.33	>100
GE-106-SW	Bat Fork Creek - Inside GE Site	9	31.2	4.06	>100
GE-107-SW	Bat Fork Creek - Downstream of GE Discharge	10	35.5	0.63	>100
GE-108-SW	Bat Fork Creek - Downstream of Station 107	9	34.1	0.78	>100
GE-109-SW	Bat Fork Creek - Downstream of GE Site	10	32.6	2.68	>100
GE-110-SW	Ditch on Seldon Clark Subsite	10	33.7	3.00	>100
CONTROL	DMW	10	24.62/31.33	3.39	>100

1 - LC50 values calculated from 5 minute readings.
2 - Control for samples 101 through 105.
3 - Control for samples 106 through 110.

Table 2 Summary of results of toxicity tests on sediment samples collected from streams near General Electric, East Flat Rock, NC. November 1994.

Sample ID #	Sampling Location	Ceriodaphnia 7 day Chronic Adult Survival	Ceriodaphnia 7 day Chronic Average # Young	Lettuce Seed Germination (% germination)	Microtox LC50-2 (%Sample)
GE-101-SD	Background for Unnamed Tributary	8	22.2	26	>100
GE-102-SD	Unnamed Tributary	10	28.6	86	>100
GE-103-SD	Bat Fork Creek - Spring Haven Trailer Park	10	16.7	88	>100
GE-104-SD	Bat Fork Creek - Shepherd Farm	10	22.5	63	83.3
GE-105-SD	Bat Fork Creek - Background for GE Site	8	22.6	65	>100
GE-106-SD	Bat Fork Creek - Inside GE Site	10	37.9	86	>100
GE-107-SD	Bat Fork Creek - Downstream of GE Discharge	9	33.6	73	>100
GE-108-SD	Bat Fork Creek - Downstream of Station 107	10	30.1	90	>100
GE-109-SD	Bat Fork Creek - Downstream of GE Site	10	26.6	83	>100
GE-110-SD	Ditch on Seldon Clark Subsite	9	29.0	49	>100
CONTROL	DMW	10	24.52/32.33	80	>100

1 - LC50 values calculated from 5 minute readings.
2 - Control for samples 101 through 105.
3 - Control for samples 106 through 110.

Table 3 Results of fish tissue analyses, GE/Shepherd Farm Superfund Site, East Flat Rock, North Carolina.

Sampling Station	Pesticides (mg/kg) DDE	PCB-1248	PCB-1016	Metals (mg/kg) Copper	Zinc
102	0.050U	0.32J	0.030	1.7	34
103	0.050U	0.49	0.45U	0.88	39
104	0.051U	0.49	0.45U	0.91	39
105	0.18	1.6	1.5U	0.95	39
106	0.12	1.4C	1.0U	1.2	42
107	0.061	1.4C	1.0U	1.0U	26
108	0.093	1.9C	1.5U	0.86	44
109	0.19	2.8C	2.5U	0.95	31

U-Material was analyzed for but not detected. The number is the minimum quantitation limit.
C-Confirmed by GC/MS.

shaded values - Exceed levels of concern for total PCB residues (0.4 mg/kg fresh weight) in whole body fish (Eisler 1986).

Table 4 Comparison of habitat quality for sampling stations on Bat Fork Creek and an unnamed tributary in the vicinity of General Electric/Shepherd Farm Superfund Site, East Flat rock, North Carolina, November 1994.

SAMPLING STATIONS		Habitat Assessment			
Station #	Station Description	Score	Habitat Condition	% Compatibility to Background	Compatibility Assessment
101	Background for Unnamed Tributary	99	Good	100	-
102	Unnamed Tributary	114	Excellent	115	Comparable
103	Bat Fork Creek (Spring Haven Trailer Park)	119	Excellent	-	-
104	Bat Fork Creek Shepherd Farm	115	Excellent	-	-
105	Bat Fork Creek Background for GE Site	125	Excellent	100	-
106	Bat Fork Creek Inside GE Site	94	Good	75	Supporting
107	Bat Fork Creek Downstream of GE Discharge	111	Excellent	88	Supporting
108	Bat Fork Creek Downstream of Sta.107	120	Excellent	96	Comparable
109	Bat Fork Creek Downstream of GE Site	117	Excellent	94	Comparable
110	Ditch on Seldon Clark Subsite	31	Poor	-	-

The chemicals of potential concern in soil are chromium VI, copper, lead, cadmium, molybdenum, aluminum, vanadium, manganese, benzo(a)anthracene, chrysene, benzo(b and/or k)fluoranthene, benzo-a-pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, dieldrin, toxaphene, PCB-1254, PCB-1242, PCB-1248, and PCB-1260.

Once these chemicals of potential concern were identified, exposure concentrations in each media were estimated. Exposure point concentrations were calculated for groundwater and surface soils using the lesser of the 95 percent upper confidence limit concentration or the maximum detected value as the reasonable maximum exposure (RME) point concentration. Exposure point concentrations for groundwater are shown in Table 5. Exposure point concentrations for each subsite are presented in Table 6 for soils.

B. Exposure Assessment

The exposure assessment evaluates and identifies complete pathways of exposure to human population on or near the Site.

Current exposure pathways include exposure through incidental ingestion of soil, inhalation of fugitive dusts from soils; dermal contact with soils; and ingestion of water from private wells. Land use assumptions include residential, commercial/ industrial and child visitor scenario.

Future use scenarios consider construction of a water supply well within the groundwater contaminant plume at GE and Shepherd Farm and ingestion of soil, inhalation of dusts and dermal contact with soils at Shepherd Farms, as a worse-case scenario. Possible exposure pathways for groundwater include exposure to contaminants of concern from the groundwater plume in drinking water and through inhalation of volatiles evolved from water through household water use. Table 7 shows the site conceptual model used to determine the risk at this Site. Further detail and mathematical calculations can be reviewed in the Baseline Risk Assessment.

C. Toxicity Assessment

Under current EPA guidelines, the likelihood of adverse effects occurring in humans from carcinogens and noncarcinogens are considered separately. These are discussed below. Tables 8 and 9 summarize the carcinogenic and noncarcinogenic toxicity criteria for the chemicals of potential concern.

Cancer slope factors have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Slope factors, which are expressed in units of kg-day/mg, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upperbound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

TABLE 5
Reasonable Maximum Exposure Concentrations for
Chemicals of Potential Concern In Groundwater
General Electric Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Mean of Transformed Data	Standard Deviation of Data	H (Statistic from Table)	Sample Size	UCL (1) (ug/l)	Maximum (ug/l)	RME (ug/l)
BARIUM	4.0	1.4	3.077	27	379	4000	379
BERYLLIUM	-0.2	0.8	2.202	27	2	15	2
MOLYBDENUM	0.4	0.7	2.102	27	3	25	3
NICKEL	1.3	1.0	2.423	27	11	190	11
LEAD	1.5	0.3	1.793	27	5	15	5
STRONTIUM	4.5	1.7	3.437	27	1216	8000	1216
ALUMINUM	5.6	1.8	3.437	27	4462	15000	4462
MANGANESE	4.2	2.2	3.812	27	3587	5000	3587
VINYL CHLORIDE	1.7	1.4	3.077	27	35.0	2.8	2.8
METHYLENE CHLORIDE	1.8	1.4	3.077	27	34.8	5.1	5.1
1,1-DICHLOROETHENE	1.7	1.4	3.077	27	36.2	0.8	0.8
CIS-1,2-DICHLOROETHENE	2.2	1.9	3.812	27	204.9	380.0	204.9
TRANS-1,2-DICHLOROETHEN	1.6	1.4	3.077	27	29.1	33.0	29.1
CHLOROFORM	1.9	1.3	2.737	27	33.0	9.4	9.4
1,2-DICHLOROETHANE	1.9	1.4	3.077	27	46.5	130.0	46.5
BROMODICHLOROMETHANE	1.7	1.5	3.077	27	39.0	0.7	0.7
1,2-DICHOLOROPROPANE	1.7	1.4	3.077	27	37.4	0.5	0.5
TRICHLOROETHENE	1.9	1.6	3.077	27	61.5	130.0	61.5
BENZENE	1.7	1.4	3.077	27	37.5	2.7	2.7
TETRACHLOROETHENE	3.4	2.4	4.588	27	4246	1600	1600
1,4-DICHLOROBENZENE	1.7	1.4	3.077	27	36.1	0.8	0.8
1,2,4-TRIMETHYLBENZENE	1.7	1.4	3.077	27	37.6	0.5	0.5
NITROBENZENE	1.7	0.4	1.856	27	6.9	36.0	6.9
2,4-DINITROPHENOL	2.3	0.3	1.793	27	11.1	10.0	10.0

TABLE 5
Reasonable Maximum Exposure Concentrations for
Chemicals of Potential Concern In Groundwater
Shepherd Farm Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Mean of Transformed Data	Standard Deviation of Data	H (Statistic from Table)	Sample Size	UCL (1) (ug/l)	Maximum (ug/l)	RME (ug/l)
BARIUM	4.6	1.4	7.120	4	67737	760	760
BERYLLIUM	-0.4	0.6	3.287	4	2.4	1.6	1.6
MANGANESE	5.6	1.7	8.250	4	3293793	1500	1500
VINYL CHLORIDE	0.7	0.4	2.651	4	4	1.1	1.1
TETRACHLOROETHENE	2.2	1.5	7.120	4	12571	34	34

UCL: Upper Confidence Limit
Maximum: The highest detected concentration.
RME: Reasonable Maximum Exposure (UCL or maximum when UCL is greater than maximum)
NA: Not Applicable
(1). Some UCL calculated values are unreasonably high due to the small sample size and/or wide range in results.

TABLE 6
Reasonable Maximum Exposure Concentrations for
Chemicals of Potential Concern In Soil
General Electric Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Mean of Transformed Data	Standard Deviation of Data	H(Statistic from Table)	Sample Size	UCL (1) (mg/kg)	Maximum (mg/kg)	RME (mg/kg)
CHROMIUM VI	3.4	0.8	2.443	17	63	120	63
COPPER	3.5	1.1	2.744	17	117	1100	117
LEAD	3.4	0.5	2.068	17	44	130	44
VANADIUM	3.8	0.5	2.068	17	66	92	66
ALUMINUM	10.5	0.5	2.068	17	52409	120000	52409
MANGANESE	5.3	0.8	2.443	17	468	860	468
BENZO(A)ANTHRACENE	5.5	0.9	2.589	17	0.7	0.4	0.4
CHRYSENE	5.5	0.9	2.589	17	0.7	0.4	0.4
BENZO(B AND/OR K)FLUORANTHENE	5.6	0.9	2.589	17	0.7	0.5	0.5
BENZO-A-PYRENE	5.5	0.9	2.589	17	0.6	0.3	0.3
INDENO(1,2,3-CD)PYRENE	5.5	0.9	2.589	17	0.6	0.2	0.2
DIBENZO(A,H)ANTHRACENE	5.4	0.9	2.589	17	0.6	0.1	0.1
DIELDRIN	2.5	1.4	3.612	17	0.1	0.1	0.1
TOXAPHENE	6.8	2.7	5.557	17	1678	2.6	2.6
PCB-1242	3.5	1.7	4.061	17	0.9	22.0	0.9
PCB-1254	3.9	2.0	4.564	17	3.2	9.3	3.2
PCB-1248	3.7	1.6	3.612	17	0.6	9.7	0.6
PCB-1260	4.2	2.1	4.564	17	5.9	26.0	5.9

TABLE 6
Reasonable Maximum Exposure Concentrations for Chemicals of Potential Concern In Soil
Shepherd Farm Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Mean of Transformed Data	Standard Deviation of Data	H(Statistic from Table)	Sample Size	UCL (1) (mg/kg)	Maximum (mg/kg)	RME (mg/kg)
CADMIUM	0.7	0.9	2.902	10	7	10	7
CHROMIUM VI	3.7	0.3	1.977	10	52	62	52
COPPER	5.6	1.9	5.396	10	57908	20000	20000
MOLYBDENUM	1.9	1.0	3.103	10	31	50	31
LEAD	5.0	1.7	4.795	10	9431	9600	9431
MANGANESE	5.6	0.3	1.977	10	378	470	378
PCB-1254	4.7	2.7	6.621	10	1441	7.3	7.3
PCB-1248	6.9	2.6	6.621	10	7728	11.0	11.0
PCB-1260	5.9	2.6	6.621	10	2887	4.0	4.0

UCL: Upper Confidence Limit
Maximum: The highest detected concentration.
RME: Reasonable Maximum Exposure (UCL or maximum when UCL is greater than maximum)
NA: Not Applicable
(1). Some UCL calculated values are unreasonably high due to the large range of detections and/or small sample size.

TABLE 7
SITE CONCEPTUAL MODEL

SOURCE	PRIMARY RELEASE/ TRANSPORT MECHANISM	AFFECTED MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	RECEPTOR
SHEPHERD FARM LANDFILL	NA	SURFACE SOIL	ON-SITE	INGESTION DERMAL CONTACT	RESIDENT VISITOR
	LEACHING	GROUNDWATER	ON-SITE	INGESTION INHALATION OF VOCS	RESIDENT*
	SURFACE EROSION	SURFACE WATER IN CREEK	OFF-SITE	INGESTION DERMAL CONTACT	RESIDENT VISITOR
		SEDIMENT IN CREEK	OFF-SITE	INGESTION DERMAL CONTACT	RESIDENT VISITOR
	DUST GENERATION	AIR	OFF-SITE	INHALATION	RESIDENT VISITOR
GE	NA	SURFACE SOIL	ON-SITE	INGESTION DERMAL CONTACT	WORKER VISITOR
LANDFILLS LANDSPREADING PLOTS TREATMENT PONDS	LEACHING	GROUNDWATER	ON- AND OFF-SITE	INGESTION INHALATION OF VOCS	WORKER RESIDENT
	SURFACE EROSION	SURFACE WATER IN CREEK	OFF-SITE	INGESTION DERMAL CONTACT	VISITOR
		SEDIMENT IN CREEK	OFF-SITE	INGESTION DERMAL CONTACT	VISITOR
	DUST GENERATION	AIR	ON-SITE	INHALATION	WORKER VISITOR

* Includes children who are not permitted to reside in the mobile home community but may visit.

TABLE 8
Cancer Slope Factors, Tumor Sites and EPA Cancer Classifications for
Chemicals of Potential Concern
General Electric Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Cancer Slope Factor/Unit Risk CSFo	Unit Risk (Inh)	CSFi	ABSeff	CSFd	Tumor Sites Oral	Inhalation	EPA CLASS
BARIUM	NA	NA	NA	NA	NA	NA	NA	D
BERYLLIUM	4.3E+00 i	2.4E-03 i	8.4E-00 i	20%	2.2E-01	All sites	Lung	B2
CADMIUM	NA	1.8E-03 i	6.3E+00 i	NA	NA	NA	Lung, trachea	B1
CHROMIUM VI	NA	1.2E-02 i	4.2E+01 i	NA	NA	NA	Lung	A
COPPER	NA	NA	NA	NA	NA	NA	NA	D
MOLYBDENUM	NA	NA	NA	NA	NA	NA	NA	D
NICKEL	NA	NA	NA	NA	NA	NA	NA	D
LEAD	NA	NA	NA	NA	NA	Kidney	NA	B2
STRONTIUM	NA	NA	NA	NA	NA	NA	NA	D
VANADIUM	NA	NA	NA	NA	NA	NA	NA	D
ALUMINUM	NA	NA	NA	NA	NA	NA	NA	D
MANGANESE	NA	NA	NA	NA	NA	NA	NA	D
VINYL CHLORIDE	1.9E+00 h	8.4E-05 h	2.9E-01 h	80%	2.4E+00	Lung, liver	Liver	A
METHYLENE CHLORIDE	7.5E-03 i	4.7E-07 i	1.65E-03 i	80%	9.4E-03	Liver	Liver, mammaries	B2
CARBON DISULFIDE	NA	NA	NA	NA	NA	NA	NA	D
1,1,DICHLOROETHENE	6E-01 i	5.0E-05 i	1.75E-01 i	80%	7.5E-01	Adrenals	Kidney	C
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	D
TRANS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	D
CHLOROFORM	6.1E-03 i	2.3E-05 i	8.05E-02 i	80%	7.6E-03	Kidney	Liver	B2
1,2-DICHLOROETHANE	9.1E-02 i	2.6E-05 i	9.1E-02 i	80%	1.1E-01	Several sites	Several sites	B2
BROMODICHLOROMETHANE	6.2E-02 i	NA	NA	NA	NA	Kidney	NA	B2
1,2-DICHLOROPROPANE	6.8E-02 h	NA	NA	NA	NA	Liver	NA	B2
TRICHLOROETHENE	1.1E-02 w	l.7E-06 e	6.0E-03 e	80%	1.4E-02	Liver	Liver	B2
BENZENE	2.9E-02 i	8.3E-06 i	2.9E-02 i	80%	3.6E-02	Leukemia	Leukemia	A
TETRACHLOROETHENE	5.2E-02 e	5.9E-07 e	2.05E-03 e	80%	6.5E-02	Liver	Liver	B2
1,4-DICHLOROBENZENE	2.4E-02 h	NA	NA	80%	NA	Liver	NA	B2
1,2,4-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	D
NITROBENZENE	NA	NA	NA	NA	NA	NA	NA	D
2,4-DINITROPHENOL	NA	NA	NA	NA	NA	NA	NA	D
BENZ0(A)ANTHRACENE	7.3E-01 e	NA	3.1E-01 e	50%	1.5E+00	Forestomach	Respiratory tract	B2

CHRYSENE	7.3E-03 e	NA	3.1E-03 e	50%	1.5E-02	Forestomach	Respiratory tract	B2
BENZO(B AND/OR K)FLUOR-ANTHENE*	7.3E-01 e	NA	3.1E-01 e	50%	1.5E+00	Forestomach	Respiratory tract	B2
BENZO(A)PYRENE	7.3E+00 i	NA	3.1E+00 e	50%	1.5E+01	Forestomach	Respiratory tract	B2
INDENO(1,2,3-CD)PYRENE	7.3E-01 e	NA	3.1E-01 e	50%	1.5E+00	Forestomach	Respiratory tract	B2
DIBENZO(A,H)ANTHRACENE	7.3E+00 e	NA	3.1E+00 e	50%	1.5E+01	Forestomach	Respiratory tract	B2
DIELDRIN	1.6E+01 i	4.6E-03 i	1.6E+01 i	50%	3.2E+01	Liver	Liver	B2
TOXAPHENE	1.1E+00 i	3.2E-04 i	1.1E+00 i	50%	2.2E+00	Liver	Liver	B2
PCB-1242	7.7E+00 i	NA	NA	50%	1.5E+01	Liver	NA	B2
PCB-1254	7.7E+00 i	NA	NA	50%	1.5E+01	Liver	NA	B2
PCB-1248	7.7E+00 i	NA	NA	50%	1.5E+01	Liver	NA	B2
PCB-1260	7.7E+00 i	NA	NA	50%	1.5E+01	Liver	NA	B2

Sources:

i - IRIS
h - HEAST
e - ECAO
w - Withdrawn from IRIS or HEAST
* - Relative potency of benzo(b)fluoranthane used

EPA Class:

A - Human carcinogen
B - Probable human carcinogen
C - Possible human carcinogen
D - Not classifiable as a human carcinogen

CSFo - Cancer Slope Factor (oral), (mg/kg/day)-1
Unit Risk (inhalation)-(ug/cu m)-1
CSFi - Cancer Slope Factor (inhalation), (mg/kg/day)-1
CSFd - Cancer Slope Factor (dermal), (mg/kg/day)-1
ABSeff - Absorption efficiency: 20% inorganics, 50% semivolatiles, 80% volatiles
NA - Not Applicable (no data)

TABLE 9
Reference Doses and Target Sites for
Chemicals of Potential Concern
General Electric Site
East Flat Rock, North Carolina

Chemical of Potential Concern	Reference Dose/Concentration Rfdo	RfC	RfDi	ABSeff	RfDd	Target Sites/Effects Oral	Inhalation
BARIUM	7E-02 i	5E-04 h	1.43E-04 h	20%	1E-02	Incr. blood pressure	Fetotoxicity
BERYLLIUM	5E-03 i	NA	NA	20%	1E-03	NOAEL	NA
CADMIUM (water)	5E-04 i	NA	NA	20%	1E-04	Proteinuria	NA
CADMIUM (food)	1E-03 i	NA	NA	20%	2E-04	NOAEL	NA
CHROMIUM VI	5E-03 i	NA	NA	20%	1E-03	NOAEL	NA
COPPER	3.71E-02 h	NA	NA	20%	7E-03	GI irritation	NA
MOLYBDENUM	5E-03 i	NA	NA	20%	1E-03	Incr. uric acid levels	NA
NICKEL	2E-02 i	NA	NA	20%	4E-03	Decr.body/organ wts.	NA
LEAD	NA	NA	NA	NA	NA	CNS effects, blood	CNS effects, blood
STRONTIUM	6E-01 i	NA	NA	20%	1E-01	Rachitic bone	NA
VANADIUM	7E-03 h	NA	NA	20%	1E-03	NOAEL	NA
ALUMINUM	1E+00 e	NA	NA	20%	2E-01	Unspecified	NA
MANGANESE (water)	5E-03 i	NA	NA	20%	1E-03	CNS effects	NA
MANGANESE (food)	1.4E-01 i	5E-05 i	1.43E-05 i	20%	3E-02	NOAEL	NOAEL
VINYL CHLORIDE	NA	NA	NA	80%	NA	NA	NA
METHYLENE CHLORIDE	6E-02 i	3E+00 h	8.57E-01 h	80%	5E-02	Liver	Liver
CARBON DISULFIDE	1E-01 i	NA	2.86E-03 h	80%	8E-02	Fetal tox/malformation	NA
1,1,DICHLOROETHENE	9E-03 i	NA	NA	80%	7E-03	Liver	NA
CIS-1,2-DICHLOROETHENE	1E-02 h	NA	NA	80%	8E-03	Decr.hematocrit	NA
TRANS-1,2-DICHLOROETHENE	2E-02 i	NA	NA	80%	2E-02	Incr.serum phosphatase	NA
CHLOROFORM	1E-02 i	NA	NA	80%	8E-03	Fatty cyst in liver	NA
1,2-DICHLOROETHANE	NA	NA	2.86E-03 e	NA	NA	NA	Not specified
BROMODICHLOROMETHANE	2E-02 i	NA	NA	80%	2E-02	Renel cytomegaly	NA
1,2-DICHLOROPROPANE	NA	4E-03 i	1.14E-03 i	NA	NA	NA	Nasal mucosa
TRICHLOROETHENE	6E-03 e	NA	NA	80%	5E-03	Liver	NA
BENZENE	NA	NA	1.71E-03 e	NA	NA	NA	Not specified

TETRACHLOROETHENE	1E-02 i	NA	NA	80%	8E-03	Liver	NA
1,4-DICHLOROBENZENE	NA	8E-01 i	2.29E-01 i	NA	NA	NA	Liver
1,2,4-TRIMETHYLBENZENE	5E-04 e	NA	NA	80%	4E-04	Not specified	NA
NITROBENZENE	5E-04 i	2E-03 h	5.71E-04 h	80%	4E-04	Blood, adrenal, kidney	Blood
2,4-DINITROPHENOL	2E-03 i	NA	NA	80%	2E-03	Cataract formation	NA
BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
CHRYSENE	NA	NA	NA	NA	NA	NA	NA
BENZO(B AND/OR K)FLUOR-ANTHENE	NA	NA	NA	NA	NA	NA	NA
BENZO-(A)-PYRENE	NA	NA	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA
DIBENZO(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA
DIELDRIN	5E-05 i	NA	NA	50%	3E-05	Liver	NA
TOXAPHENE	NA	NA	NA	NA	NA	NA	NA
PCB-1242	NA	NA	NA	NA	NA	NA	NA
PCB-1254	2E-05 i	NA	NA	50%	1E-05	Eyes,nails,immune syst.	NA
PCB-1248	NA	NA	NA	NA	NA	NA	NA
PCB-1260	NA	NA	NA	NA	NA	NA	NA

Sources:

RfDo - Reference Dose (oral), (mg/kg/day)
RfC - Reference Concentration (air) (mg/cu m)
RfDi - Reference Dose (inhalation) (mg/kg/day)
ABSeff - Absorption efficiency: 20% inorganics, 50% semivolatiles, 80% volatiles
RfDd - Reference Dose (dermal), (mg/kg/day)
NA - Not Applicable (no data)

i - IRIS
h - HEAST
e - ECAO

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

D. Risk Characterization

The risk characterization step of the Site risk assessment process integrates the toxicity and exposure assessments into quantitative and qualitative expressions of risk. The output of this process is a characterization of the Site-related potential noncarcinogenic and carcinogenic health effects.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ), or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably exposed, the Hazard Index (HI) can be generated. Calculation of a HI in excess of unity indicates the potential for adverse health effects. Indices greater than one will be generated anytime intake for any of the chemicals of concern exceeds its Reference Dose (RfD). However, given a sufficient number of chemicals under consideration, it is also possible to generate a HI greater than one even if none of the individual chemical intakes exceeds their respective RfDs.

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure. Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. EPA's acceptable target range for carcinogenic risk is one-in-ten-thousand (1E-4) to one-in-one-million (1E-6).

Current Use

Cancer and noncancer risks for the current use scenario for the Shepherd Farm Site are summarized in Table 10. Noncancer health effects are considered possible for an adult and child resident, as well as a lifetime resident. Noncancer health effects are not expected for the site visitor. Estimates of cancer risk for a child resident (3E-04), adult resident (2E-04) and the lifetime resident (4E-04) were above the acceptable range.

TABLE 10
Summary of Cancer and Noncancer Risks by Exposure Route
Current Use Scenario
Shepherd Farm Site
East Flat Rock, North Carolina

Location	Exposure Route	Child Resident Cancer	Child Resident HI	Adult Resident Cancer	Adult Resident HI	Lifetime Resident (6-yr + 24-yr) Cancer	Lifetime Resident (6-yr + 24-yr) HI	Site Visitor Cancer	Site Visitor HI
Site Surface Soil	Inadvertent Ingestion	2E-04	12	8E-05	1	3E-04	3	4E-06	0.1
	Dermal Contact	9E-05	3	8E-05	0.7	2E-04	1	4E-06	0.1
	Inhalation of Dust	3E-07	8E-12	3E-07	2E-12	6E-07	3E-12	1E-08	2E-13
Stream Water	Inadvertent Ingestion	1E-09	0.00003	1E-09	0.00001	3E-09	0.00001	8E-10	0.00001
	Dermal Contact	9E-09	0.0002	8E-09	0.00004	2E-08	0.0001	5E-09	0.0001
Stream Sediment	Inadvertent Ingestion	NA	0.001	NA	0.0001	NA	0.0002	NA	0.0002
	Dermal Contact	NA	0.0001	NA	0.00003	NA	0.00005	NA	0.00005
TOTAL CURRENT RISK		3E-04	15	2E-04	2	4E-04	5	7E-06	0.2

HI Hazard Index (noncancer risk)
NA Not Applicable

Future Use

Cancer and noncancer risks associated with the future use scenario are summarized in Table 11 for the GE Site and Table 12 for the Shepherd Farm Site. As measured by hazard indices, noncancer health effects are considered possible due to ingestion of groundwater obtained from within the contaminant plume. Unacceptable cancer risks are also considered possible due to the contamination.

Contaminant Risk

The quantified carcinogenic risks and noncarcinogenic hazard indices for each chemical of concern are given in Tables 13, 14, and 15 for soil and groundwater.

E. Ecological Risk Assessment

Potential pathways by receptor groups is shown in Table 16. The exposure media are surface soils, sediments, and surface waters. Bat Fork Creek along the GE property has been impacted by releases from the site; however, the stream appears to be recovering as it flows past the Site. PCBs were detected in fish at levels that are considered harmful. Additional downstream fish tissue sampling is recommended to fully characterize the extent of PCB contamination in the fish population and to assess potential impacts on secondary consumers (e.g., kingfishers, heron, or other fish-eating species) that are known to occur downstream of the site. EPA will incorporate this sampling as part of the remedy.

F. Conclusions

Actual or threatened releases of hazardous substances from this Site if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

VII. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

In accordance with Section 121 of CERCLA, remedial actions must be protective of human health and the environment and must comply with all federal, state, and local applicable or relevant and appropriate requirements. The remediation goals must meet regulatory requirements and protect human health and the environment. This section will present the ARARs and present the remediation goals.

TABLE 11
Summary of Cancer and Noncancer Risks by Exposure Route
Future Use Scenario
General Electric Site
East Flat Rock, North Carolina

Location	Exposure Route	Child Resident Cancer	Child Resident HI	Adult Resident Cancer	Adult Resident HI	Lifetime Resident (6-yr + 24-yr) Cancer	Lifetime Resident (6-yr + 24-yr) HI	On-site Worker Cancer	On-site Worker HI	Site Visitor Cancer	Site Visitor HI
Site Surface Soil	Inadvertent Ingestion	NA	NA	NA	NA	NA	NA	2E-05	0.1	2E-06	0.04
	Dermal Contact	NA	NA	NA	NA	NA	NA	1E-05	0.1	2E-06	0.03
	Inhalation of Dust	NA	NA	NA	NA	NA	NA	3E-07	2E-12	2E-08	3E-13
Stream Water	Inadvertent Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	2E-09	0.01
	Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	1E-08	0.001
Stream Sediment	Inadvertent Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	6E-08	0.001
	Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	6E-08	0.001
Groundwater	Ingestion	6E-04	60	9E-04	26	2E-03	34	4E-04	9	NA	NA
	Inhalation of VOCs	NA	NA	9E-05	0.8	9E-05	0.8	3E-05	0.3	NA	NA
TOTAL FUTURE RISK		6E-04	60	1E-03	27	2E-03	35	4E-04	10	4E-06	0.1

HI Hazard Index (noncancer risk)
NA Not Applicable

TABLE 12
Summary of Cancer and Noncancer Risks by Exposure Route
Future Use Scenario
Shepherd Farm Site
East Flat Rock, North Carolina

Location	Exposure Route	Child Resident Cancer	Child Resident HI	Adult Resident Cancer	Adult Resident HI	Lifetime Resident (6-yr + 24-yr) Cancer	Lifetime Resident (6-yr + 24-yr) HI	Site Visitor Cancer	Site Visitor HI
Site Surface Soil	Inadvertent Ingestion	2E-04	12	8E-05	1	3E-04	3	4E-06	0.1
	Dermal Contact	9E-05	3	8E-05	0.7	2E-04	1	4E-06	0.1
	Inhalation of Dust	3E-07	8E-12	3E-07	2E-12	6E-07	3E-12	1E-08	2E-13
Stream Water	Inadvertent Ingestion	1E-09	0.00003	1E-09	0.00001	3E-09	0.00001	8E-10	0.00001
	Dermal Contact	9E-09	0.0002	8E-09	0.00004	2E-08	0.0001	5E-09	0.0001
Stream Sediment	Inadvertent Ingestion	NA	0.001	NA	0.0001	NA	0.0002	NA	0.0002
	Dermal Contact	NA	0.0001	NA	0.00003	NA	0.00005	NA	0.00005
Groundwater	Ingestion	6E-05	20	1E-04	9	2E-04	11	NA	NA
	Inhalation of VOCs	NA	NA	4E-06	NA	4E-06	NA	NA	NA
TOTAL FUTURE RISK		3E-04	35	3E-04	11	6E-04	16	7E-06	0.2

HI Hazard Index (noncancer risk)

TABLE 13
CHEMICALS OF CONCERN - SOIL

CHEMICALS OF CONCERN	INCIDENTAL INGESTION		DERMAL CONTACT		INHALATION OF DUST		SELECTION BASIS
	CANCER RISK	HAZARD QUOTIENT	CANCER RISK	HAZARD QUOTIENT	CANCER RISK	HAZARD QUOTIENT	
SHEPHERD FARM CHILD RESIDENT SCENARIO							
CADMIUM	NA	0.1	NA	0.01	6E-09	NA	1
CHROMIUM VI	NA	0.1	NA	0.02	3E-07	NA	1
COPPER	NA	7	NA	0.9	NA	NA	1
MOLYBDENUM	NA	0.1	NA	0.01	NA	NA	1
PCB-1254	6E-05	5	3E-05	2	NA	NA	1
PCB-1248	9E-05	NA	5E-05	NA	NA	NA	1
PCB-1260	3E-05	NA	2E-05	NA	NA	NA	1
SHEPHERD FARM ADULT RESIDENT SCENARIO							
COPPER	NA	0.7	NA	0.2	NA	NA	1
PCB-1254	3E-05	0.5	3E-05	0.5	NA	NA	1
PCB-1248	4E-05	NA	4E-05	NA	NA	NA	1
PCB-1260	1E-05	NA	1E-05	NA	NA	NA	1
GE ON-SITE WORKER SCENARIO							
PCB-1242	1E-06	NA	9E-07	NA	NA	NA	1
PCB-1254	4E-06	0.1	3E-06	0.1	NA	NA	1
PCB-1260	8E-06	NA	6E-06	NA	NA	NA	1

TABLE 14
Chemicals of Concern - Groundwater
General Electric Site
East Flat Rock, North Carolina

Chemicals of Concern	Ingestion Cancer Risk	Ingestion Hazard Quotient	Inhalation of VOCs Cancer Risk	Inhalation of VOCs Hazard Quotient	Selection Basis
On - site Worker Scenario					
BARIUM	NA	0.1	NA	NA	1,2
BERYLLIUM	2E-05	0.003	NA	NA	1,2
NICKEL	NA	0.01	NA	NA	2
LEAD	NA	NA	NA	NA	2
MANGANESE	NA	7	NA	NA	1,2
VINYL CHLORIDE	2E-05	NA	3E-06	NA	1,2
METHYLENE CHLORIDE	1E-07	0.001	3E-08	0.0001	2
1,1-DICHLOROETHENE	2E-06	0.001	5E-07	NA	1
CIS-1,2-DICHLOROETHENE	NA	0.2	NA	NA	1,2
CHLOROFORM	2E-07	0.01	3E-06	NA	1,2
1,2-DICHLOROETHANE	1E-05	NA	1E-05	0.2	1,2
TRICHLOROETHENE	2E-06	0.1	1E-06	NA	1,2
BENZENE	3E-07	NA	3E-07	0.02	2
TETRACHLOROETHENE	3E-04	2	1E-05	NA	1,2
NITROBENZENE	NA	0.1	NA	0.1	1
Child Resident Scenario					
BARIUM	NA	0.3	NA	NA	1,2
BERYLLIUM	4E-05	0.02	NA	NA	1,2
NICKEL	NA	0.03	NA	NA	2
LEAD	NA	NA	NA	NA	2
STRONTIUM	NA	0.1	NA	NA	1
ALUMINUM	NA	0.3	NA	NA	1
MANGANESE	NA	46	NA	NA	1,2
VINYL CHLORIDE	3E-05	NA	NA	NA	1,2
METHYLENE CHLORIDE	2E-07	0.01	NA	NA	2
1,1-DICHLOROETHENE	3E-06	0.01	NA	NA	1
CIS-1,2-DICHLOROETHENE	NA	1	NA	NA	1,2
TRANS-1,2-DICHLOROETHENE	NA	0.1	NA	NA	1
CHLOROFORM	3E-07	0.1	NA	NA	1,2
1,2-DICHLOROETHANE	2E-05	NA	NA	NA	1,2
TRICHLOROETHENE	4E-06	0.7	NA	NA	1,2
BENZENE	4E-07	NA	NA	NA	2
TETRACHLOROETHENE	5E-04	10	NA	NA	1,2
1,2,4-TRIMETHYLBENZENE	NA	0.1	NA	NA	1
NITROBENZENE	NA	0.9	NA	NA	1
2,4-DINITROPHENOL	NA	0.3	NA	NA	1

Adult Resident Scenario

BARIUM	NA	0.1	NA	NA	1,2
BERYLLIUM	6E-05	0.01	NA	NA	1,2
NICKEL	NA	0.01	NA	NA	2
LEAD	NA	NA	NA	NA	2
STRONTIUM	NA	0.1	NA	NA	1
ALUMINUM	NA	0.1	NA	NA	1
MANGANESE	NA	20	NA	NA	1,2
VINYL CHLORIDE	5E-05	NA	8E-06	NA	1,2
METHYLENE CHLORIDE	4E-07	0.002	8E-08	0.0002	2
1,1-DICHLOROETHENE	4E-06	0.002	1E-06	NA	1
CIS-1,2-DICHLOROETHENE	NA	0.6	NA	NA	1,2
CHLOROFORM	5E-07	0.03	7E-06	NA	1,2
1,2-DICHLOROETHANE	4E-05	NA	4E-05	0.4	1,2
TRICHLOROETHENE	6E-06	0.3	3E-06	NA	1,2
BENZENE	7E-07	NA	7E-07	0.04	2
TETRACHLOROETHENE	8E-04	4	3E-05	NA	1,2
NITROBENZENE	NA	0.4	NA	0.3	1
2,4-DINITROPHENOL	NA	0.1	NA	NA	1

1. Exceeds excess cancer risk of 1 x E-6 and/or HQ of 0.1
2. Exceeds ARAR

NA not applicable

TABLE 15
Chemicals of Concern - Groundwater
Shepherd Farm Site
East Flat Rock, North Carolina

Chemicals of Concern	Ingestion Cancer Risk	Ingestion Hazard Quotient	Inhalation of VOCs Cancer Risk	Inhalation of VOCs Hazard Quotient	Selection Basis
Child Resident Scenario					
BARIUM	NA	0.7	NA	NA	1
BERYLLIUM	4E-05	0.02	NA	NA	1
MANGANESE	NA	19	NA	NA	1
VINYL CHLORIDE	1E-05	NA	NA	NA	1,2
TETRACHLOROETHENE	1E-05	0.2	NA	NA	1,2
Adult Resident Scenario					
BARIUM	NA	0.3	NA	NA	1
BERYLLIUM	6E-05	0.01	NA	NA	1
MANGANESE	NA	8	NA	NA	1,2
VINYL CHLORIDE	2E-05	NA	3E-06	NA	1,2
TETRACHLOROETHENE	2E-05	0.1	7E-07	NA	1,2

1. Exceeds excess cancer risk of 1 x E-6 and/or HQ of 0.1
2. Exceeds ARAR

NA not applicable

TABLE 16

POTENTIAL PATHWAYS BY RECEPTOR GROUPS
GENERAL ELECTRIC/SHEPHERD FARM SITE
EAST FLAT ROCK, NORTH CAROLINA

POTENTIAL RECEPTORS	EXPOSURE MEDIA	EXPOSURE TYPE	EXPOSURE ROUTE
Soil Invertebrates, Terrestrial Plants, Amphibians, and Wildlife	Surface Soil	Direct	Absorption or Direct Contact
Soil Invertebrates and Wildlife	Soil/Grit	Direct	Ingestion
Plant-eating Invertebrates, Reptiles, and Wildlife	Surface Soil	Indirect	Diet
Aquatic Biota and Wildlife	Surface Water	Direct	Absorption or Direct Contact
Wildlife (Birds and Mammals)	Surface Water	Direct	Ingestion
Wildlife and Fish	Surface Water	Indirect	Diet
Benthic Invertebrates, Bottom-Feeding Fish, and Wildlife	Sediment	Direct	Absorption or Direct Contact
Benthic Invertebrates, and Wildlife	Sediment	Direct	Ingestion
Wildlife and Fish	Sediment	Indirect	Diet

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The requirement that ARARs be identified and complied with during the development and implementation of remedial actions is found in Section 121(d)(2) of CERCLA, 42 U.S.C. Section 9621(d)(2). This section requires that for any hazardous substance remaining onsite, all federal and state environmental and facility citing standards, requirements, criteria, or limitations shall be met at the completion of the remedial action to the degree that those requirements are legally applicable or appropriate and relevant under the circumstances presented at the site.

Three classifications of requirements are defined by EPA in the ARAR determination process:

- Chemical-specific: These requirements set protective remediation levels for the chemicals of concern.

- Location-specific: These requirements restrict remedial actions based on the characteristics of the site or its immediate surroundings, and are based on where the action takes place.

- Action-specific: These requirements set controls or restrictions on the design, implementation, and performance levels of activities related to the management of hazardous substances, pollutants, or contaminants.

A. Chemical-Specific ARARs

Chemical-specific ARARs include those laws and regulations governing the release of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. Chemical-specific requirements set health- or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, contaminants, and pollutants. These ARARs, when applied to site-specific conditions, establish numerical values that define the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Examples include drinking water standards and ambient air quality standards. Chemical-specific ARARs are established once the nature of the contamination at the site has been defined, which is accomplished during the RI. Chemical-specific ARARs for this site are listed in Table 17.

B. Location-specific ARARs

Location-specific ARARs are design requirements or activity restrictions based on the geographical or physical positions of the site and its surrounding area. Location-specific requirements set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location. Examples include areas in a flood plain, a wetland, or a historic site. Location-specific criteria are generally established early in the RI/FS process since they are not affected by the type of contaminant or the type of remedial action implemented. Location-specific ARARs for this site are listed in Table 18.

TABLE 17 - CHEMICAL-SPECIFIC ARARS, CRITERIA, AND GUIDANCE FOR THE GE/SHEPHERD FARM SITE

STANDARD, REQUIREMENT, CRITERIA, OR LIMITATION	CITATION	REQUIREMENT SYNOPSIS	COMMENT
FEDERAL Safe Drinking Water Act Section 300	40 USC		
National Primary Drinking Water Standards	40 CFR Part 141	Establishes health-based standards for public water systems (MCLs).	The MCLs for organic and inorganic contaminants are applicable to the groundwater contaminated by the site since the aquifer is a drinking water source.
National Secondary Drinking Water Standards	40 CFR 143	Establishes welfare-based standards for public water systems (secondary MCLs).	Secondary MCLs for organic and inorganic contaminants are guidelines to be considered for groundwater since it is a drinking water source.
Maximum Contaminant Level (MCL) Goals	40 CFR 141	Establishes drinking water quality goals set a levels of no known or anticipated adverse health effects.	MCLGs for organic and inorganic contaminants are applicable to the groundwater since it is a drinking water source.
Clean Water Act	33 USC Section 1251-1376		
Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	May be relevant and appropriate if groundwater, either treated or untreated, is discharged to a surface water body. Also relevant and appropriate to any runoff from contaminated soil or soil remediation activities.
Resource Conservation and Recovery Act (RCRA), as amended	42 USC 6905, 6912, 6924, 6925		
RCRA Groundwater Protection	40 CFR Part 264	Provides for groundwater protection standards, general monitoring requirements, and technical requirements.	RCRA groundwater protection standards are relevant and appropriate for groundwater at the site.
Clean Air Act	40 USC 1857		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Sets primary and secondary air standards at levels to protect public health and public welfare.	May be relevant and appropriate if onsite treatment units or excavation are a part of remedial action.
National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61	Provides emissions standards for hazardous air pollutants for which no ambient air quality standard exists.	May be relevant and appropriate if onsite treatment units or excavation are a part of remedial action.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive No. 9355.4-01	Directive which describes EPA's recommended approach for evaluating and remediating Superfund sites with PCB contamination.	
Cleanup Level Determination	Chapter 3	Describes various considerations pertinent to determining the appropriate level of PCBs that can be left in each contaminated media to achieve the protection of human health and the environment.	Guidelines to be considered for PCB-contaminated surface soils at the site.

STATE

North Carolina Drinking Water Act	130A NCAC 311-327	Regulates water systems within the state that supply drinking water that may affect the public health.	Provides the state with the authority needed to assume primary enforcement responsibility under the federal act.
North Carolina Drinking Water and Groundwater Standards	15A NCAC 2L	Establishes groundwater classification and water quality standards.	Guidelines for allowable levels of toxic organic and inorganic compounds in groundwater used for drinking water. Applicable to groundwater at the site.
North Carolina Water Quality Standards	15A NCAC 2B.0100 & 0200	Establishes a series of classifications and water quality standards for surface water.	May be applicable if treated groundwater is discharged to surface waters.
North Carolina Surface Water Effluent Limitations	15A NCAC 2B.0400	Establishes limits and guidelines for effluent discharged to waters of the state.	May be applicable if treated groundwater is discharged to surface water.
North Carolina Air Pollution Control Regulations	15A NCAC 2D	Regulates ambient air quality and establishes air quality standards for hazardous air pollutants.	May be applicable if onsite treatment or excavation is part of Remedial Action.
North Carolina Hazardous Waste Management Rules	15A NCAC 13A.0009 & .0012	Establishes standards for hazardous waste treatment facilities.	May be applicable if hazardous waste is excavated and stored or treated as part of the Remedial Action.

C. Action-specific ARARs

Action-specific ARARs are technology-based, establishing performance, design, or other similar action-specific controls or regulations for activities related to the management of hazardous substances or pollutants. Action-specific requirements are triggered by the particular remedial alternatives that are selected to accomplish the cleanup of hazardous wastes. An example includes the Resource Conservation and Recovery Act (RCRA) incineration regulations. Action-specific ARARs for this site are listed in Table 19 and Table 20 for soil and groundwater, respectively.

Media of Concern

Based on the results of the remedial investigation and the baseline risk assessment, the GE/Shepherd Farm Site is comprised of two contaminated media; soil and groundwater.

Surface water was not included as a medium of concern based on the fact that if groundwater feeding the surface water in the area is remediated and if discharge to Bat Fork Creek from the wastewater treatment ponds is terminated, surface water will be remediated. The approach used is based on remediation of the source. Surface water quality will be monitored to determine the effectiveness of this approach.

VIII. REMEDIAL ACTION OBJECTIVES

Considering the requirements for risk reduction and the risk-based remediation levels derived in the Baseline Risk Assessment, and the ARARs discussed previously, the remediation goals specifically developed for the soil in the source areas of the GE/Shepherd Farm Site are presented in Table 21. The remediation goals for groundwater across the entire site are presented in Table 22.

The remediation goals, presented in Tables 21 and 22, were selected as the most conservative of the chemical specific ARARs, the health-based risk goals, and the contract required quantitation limit (CRQL) that was attainable. The background concentration would have been selected as the remediation goal if it had exceeded the risk-based goal, as is the normal procedure. Remediation goals were also selected based on present and future land use at the site, assuming the GE Subsite would remain commercial/industrial, and Shepherd Farm Subsite to be residential.

TABLE 18 - LOCATION-SPECIFIC ARARS, CRITERIA, AND GUIDANCE FOR THE GE/SHEPHERD FARM SITE

STANDARD, REQUIREMENT, CRITERIA, OR LIMITATION	CITATION	REQUIREMENT SYNOPSIS	COMMENT
FEDERAL			
Resource Conservation and Recovery Act (RCRA), as amended	42 USC 6901		
RCRA Location Standards	40 CFR 264.18(b)	A treatment/storage/disposal (TSD) facility must be designed, constructed, operated and maintained to avoid washout on a 100-year floodplain.	May be relevant and appropriate if an onsite TSD facility is required as part of overall remediation and it exists within the 100-year floodplain.
Fish and Wildlife Conservation Act	16 USC 2901 et seq.	Requires states to identify significant habitats and develop conservation plans for these areas.	Confirmation with the responsible state agency regarding the site being located in one of these significant habitats is required.
Floodplain Management Executive Order	Executive Order 11988; 40 CFR 6.302	Actions that are to occur in floodplain should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial value.	Remedial actions are to prevent incursion of contaminated groundwater onto forested floodplain.
Endangered Species Act	16 USC 1531	Requires action to conserve endangered species or threatened species, including consultation with the Department of Interior.	Endangered species, in particular the bunched arrowhead plant, have been identified near the site.
Wetlands Management Executive Order	Executive Oder 11990; 40 CFR 6.302	Action to minimize the destruction, loss or degradation of wetlands.	Potential remedial alternatives within wetlands Requirement is relevant and appropriate.
STATE			
North Carolina Hazardous Waste Management Rules	15A NCAC 13A.0009 & .0012	Location requirements for hazardous waste treatment/storage/disposal facilities.	May be applicable to hazardous waste excavated, stored, and treated onsite.
North Carolina Solid Waste Management Rules	15A NCAC 13B.0500	Siting requirements for solid waste disposal units.	May be relevant and appropriate to nonhazardous waste disposed onsite.

TABLE 19 - ACTION-SPECIFIC ARARS, CRITERIA, AND GUIDANCE FOR SOIL FOR THE GE/SHEPHERD FARM SITE

STANDARD, REQUIREMENT, CRITERIA, OR LIMITATION	CITATION	REQUIREMENT SYNOPSIS	COMMENT
FEDERAL			
Disposal (Onsite or Offsite)			
Resource Conservation and Recovery Act (RCRA), as amended	42 USC Section 6901 et. seq.		
Classification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes.	Relevant and Appropriate
Land Disposal Restrictions	40 CFR 268.10-12 40 CFR 268 (Subpart D)	Disposal of contaminated soil and debris resulting from CERCLA response actions are subject to federal land disposal prohibitions.	Relevant and Appropriate
Department of Transportation (DOT) Hazardous Materials Transportation Act	49 USC 1801	Regulates offsite transportation of specific hazardous chemicals and wastes.	Relevant and Appropriate
Soil Treatment			
Resource Conservation and Recovery Act (RCRA), as amended	40 USC Section 6901 et. seq.		
Identification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes.	Relevant and Appropriate
Treatment of Hazardous Wastes in a Unit	40 CFR 264.601	Rules and requirements for the treatment of hazardous wastes.	Relevant and Appropriate
Requirements for Generation,Storage,Transportation, and Disposal of Hazardous Waste generators.	40 CFR 264	Regulates storage, transportation, and operation of hazardous waste	Relevant and Appropriate
Waste Piles	40 CFR 264 (Subpart L)	Regulates storage and treatment of hazardous waste in piles	Relevant and Appropriate
Tank Systems	40 CFR 264 (Subpart J)	Regulates storage and treatment of hazardous waste in tank systems	Relevant and Appropriate
Use and Management of Containers	40 CFR 264 (Subpart I)	Regulates storage of containers of hazardous waste	Relevant and Appropriate
Land Disposal Restrictions	40 CFR 268.10-12 40 CFR 268 (Subpart D)	Establishes standards for hazardous wastes.	Relevant and Appropriate
Toxic Substances Control Act (TSCA)	40 CFR 700-789		
PCBs Spill Cleanup Policy	40 CFR 761	Regulations under TSCA implementing the requirements for the cleanup of spilled PCBs.	Applicable

TABLE 19 (Continued) - ACTION-SPECIFIC ARARS, CRITERIA, AND GUIDANCE FOR SOIL FOR THE GE/SHEPHERD FARM SITE

STANDARD, REQUIREMENT, CRITERIA, OR LIMITATION	CITATION	REQUIREMENT SYNOPSIS	COMMENT
Clean Air Act			
Air Use Approval	40 CFR 60 (Subpart A)	Requires notification and performance testing by owner or operator.	Relevant and Appropriate
Particulate Discharge Limitations and Performance Testing	40 CFR 60 (Subpart B)	Defines limitations for particulate emissions, test methods, and monitoring requirements for incinerators.	Relevant and Appropriate
Other			
Occupational Safety and Health Administration	29 CFR 1910 Part 120	Provides safety rules for handling specific chemicals for site workers during remedial activities.	Applicable
STATE			
North Carolina Hazardous Waste Management Rules	15A NCAC 13A	Siting and design requirements for hazardous waste TSDs.	Relevant and Appropriate
North Carolina Solid Waste Management Rules	15A NCAC 13B	Siting and design requirements for disposal sites.	Relevant and Appropriate
North Carolina Air Pollution Control Requirements	15A NCAC 2D	Air pollution control, air quality, and emissions control standards.	Relevant and Appropriate
North Carolina Sedimentation Control Rules	15A NCAC 4	Requirements for prevention of sedimentation pollution.	Relevant and Appropriate
North Carolina Groundwater Regulations	15A NCAC 2L	Section 106 includes requirements for the cleanup and/or control of contaminant source areas.	Relevant and Appropriate

TABLE 20 - ACTION-SPECIFIC ARARS, CRITERIA, AND GUIDANCE FOR GROUNDWATER FOR THE GE/SHEPHERD FARM SITE

STANDARD, REQUIREMENT, CRITERIA, OR LIMITATION	CITATION	REQUIREMENT SYNOPSIS	COMMENT
FEDERAL Groundwater Extraction and Treatment			
Resource Conservation and Recovery Act (RCRA), as et. seq. amended.	42 USC Section 6901		
Identification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes.	Relevant and Appropriate
Treatment of Hazardous Wastes in a Unit	40 CFR 264.601 40 CFR 265.400	Rules and requirements for the treatment of hazardous wastes.	Relevant and Appropriate
Requirements for Generation, Storage Transportation, and Disposal of Hazardous Waste	40 CFR 263 40 CFR 264	Regulates storage, transportation, and operation of hazardous waste generators.	Relevant and Appropriate
Land Disposal Restrictions	40 CFR 268	Prohibits dilution as a substitute for treatment.	Relevant and Appropriate
Disposal - Discharge of Surface Water/POTW			
Clean Water Act	33 USC Section 1351-1376		
Requires use of Best Available Treatment Technology	40 CFR 122	Use of best available technology economically achievable is required to control discharge of toxic pollutants to POTW.	Relevant and Appropriate
Requires Use of Best Management Practices	40 CFR 125	Requires development and implementation of a Best Management Practices program to prevent the release of toxic constituents to surface water.	Relevant and Appropriate
National Pollutant Discharge Elimination System (NPDES) Permit Regulations	40 CFR 122 Subpart C	Use of best available technology economically achievable for toxic pollutants discharged to surface waters.	Relevant and Appropriate
Discharge must be consistent with the requirements of a Water Quality Management Plan approved by EPA	40 CFR 122	Discharge must comply with EPA-approved Water Quality Management Plan.	Relevant and Appropriate
Discharge must not increase contaminant concentration in offsite surface water.	Section 121(d)(2)(B)(iii)	Selected remedial action must establish a standard of control to maintain surface water quality.	Relevant and Appropriate
Other Occupational Safety and Health Administration	29 CFR 1910 Part 120	Provides safety rules for handling specific chemicals for site workers during remedial activities.	Applicable
STATE North Carolina Water Quality Standards	15A NCAC 2B	Surface water quality standards.	Relevant and Appropriate
North Carolina Groundwater Standards	15A NCAC 2L	Groundwater quality standards, regulates injection wells.	Relevant and Appropriate
Wastewater Discharge to Surface Waters	15A NCAC 2H	Regulates surface water discharge and discharges to POTW.	Relevant and Appropriate
North Carolina Air Pollution Control Requirements	15A NCAC 2D	Air pollution control air quality and emissions standards.	Relevant and Appropriate

TABLE 21 - REMEDIATION GOALS FOR SOIL FOR THE GE/SHEPHERD FARM SITE

CONTAMINANT	REMEDIATION GOAL SHEPHERD FARM	REMEDIATION GOAL GE	BASIS
PCBs (TOTAL)	1 MG/KG	10 MG/KG	OSWER DIRECTIVE NO. 9355.4-01

TABLE 22 - REMEDIATION GOALS FOR GROUNDWATER FOR THE GE/SHEPHERD FARM SITE

CONTAMINANT	MAX (UG/L)	REMEDIATION GOAL (UG/L)	BASIS
Organics			
Vinyl Chloride	2.8	1	CRQL (NC MCL - 0.015 ug/l)
1,2-Dichloroethene	380	70	NC MCL
Chloroform	9.4	1	CRQL (NC MCL - 0.19 ug/l)
1,2-Dichloroethane	130	1	CRQL (NC MCL - 0.38 ug/l)
Trichloroethene	130	2.8	NC MCL
Benzene	2.7	1	NC MCL
Tetrachloroethene	1,600	1	CRQL (NC MCL - 0.7 ug/l)
Nitrobenzene	36	10	HI=1
Metals			
Barium	4,000	2,000	NC MCL
Beryllium	15	4	FED MCL
Nickel	190	100	FED MCL
Lead	15	15	FEDERAL ACTION LEVEL
Manganese	5,000	50	NC MCL

HI - Hazard Index NC - North Carolina FED - Federal Safe Drinking Water Act
CRQL - Contract Required Quantitation Limit MCL - Maximum Contaminant Level

The areal extent of soil contamination above the remediation levels presented in Table 18 is presented in Figures 24 and 25. The estimated volume of soil exceeding remediation levels at the Shepherd Farm Subsite is 6,400 cubic yards, and 3,980 at the GE Subsite.

The areal extent of groundwater contamination above the remediation levels in Table 22 is presented in Figures 26 and 27. The estimated volume of groundwater exceeding remediation levels at the Shepherd Farm Subsite is 6,372,000 gallons and 1,256,752,200 gallons at the GE Subsite.

IX. DESCRIPTION OF ALTERNATIVES

Table 23 lists the remedial action alternatives developed for the GE/Shepherd Farm Site.

The alternatives designated as "SS" are applicable to the surface soils and those designated as "GW" apply to the ground water. All the alternatives except the "No Action" alternative include periodic monitoring of the ground water including onsite monitoring wells and potable wells for site indicator parameters to evaluate the site conditions and the migration of chemicals over time.

Alternative 1 - No Action

Under the no action alternative, the site is left "as is" and no funds are expended for active control or cleanup of the surface soils and ground water. The NCP requires consideration of this alternative as a baseline case for comparing other remedial actions and the level of improvement achieved. However, 5-year reviews of the site, which consist of one round of sampling selected monitoring wells and potable wells, would be conducted over an estimated 30-year period.

Alternative 2 - Institutional Actions

This alternative consists of leaving the source areas as they are without conducting any remedial action, with groundwater monitoring and institutional controls. This alternative includes maintenance of a chain-link fence around the perimeter of the source areas. Annual inspection of the fence is conducted to prevent direct exposure to impacted site soils. Repair is instituted upon report of vandalism or other acts which result in unrestricted access. This alternative also includes deed, permit and zoning restrictions on and near the property that prohibit excavation, regrading, development of the site, ground-water usage, issuance of well drilling permits, or any other activities that may cause exposure to impacted soils and ground water. The 5-year reviews would be required because concentrations of chemicals remain at the site above levels that allow unlimited use of the site.

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TABLE 23 - REMEDIAL ACTION ALTERNATIVES FOR SURFACE SOILS AND GROUNDWATER FOR THE GE/SHEPHERD FARM SITE

ALTERNATIVE	DESCRIPTION
Alternative 1	No Action
Alternative 2	Institutional Action
Alternative SS3	Excavation of the 0 to 12 inch zone of surface soils. Disposal of soils in a RCRA Subtitle D MSWLF.
Alternative SS4	Excavation of the 0 to 12 inch zone of surface soils. Disposal on-site as backfill. Soils will require treatment to Remediation goals prior to disposal. Treatment may consist of soil washing, solidification/stabilization or ex-situ bioremediation.
Alternative SS5	Containment with placement of a cap. Excavation of the 0 to 12 inch zone of surface soils at the Shepherd Farm Subsite. Transportation of these soils to the dry sludge impoundment area of the GE Subsite. Capping of the dry sludge impoundment area, Landfills A and B on GE Subsite. Used in conjunction with surface and dust control as well as diversion and collection of surface water.
Alternative GW6a	Pump and treat affected ground water. Treatment may include filtration, air stripping, GAC adsorption or oxidation. Discharge treated ground water on site via surface water.
Alternative GW6b	Pump and treat affected ground water. Treatment may include filtration, air stripping, GAC adsorption or oxidation. Discharge treated groundwater off site via POTW.
Alternative GW7a	Ground-water treatment consisting of a combination of in-situ bioremediation and ex-situ treatment as noted in Alternative GW6. Discharge treated ground water on site via surface water.
Alterative GW7b	Ground-water treatment consisting of a combination of in-situ bioremediation and ex-situ treatment as noted in Alternative GW6. Discharge treated ground water off site via POTW.

All the alternatives except 1 include periodic monitoring of the groundwater for site indicator parameters to evaluate the site conditions and the migration of chemicals over time.

Alternative SS3-Excavation; Off-site Disposal

This alternative requires the excavation of the surficial soils at the site which are impacted at concentrations exceeding the Remedial Action Goals and disposal off-site in a RCRA Subtitle D Municipal Waste Landfill (MSWLF). Surficial soils are defined as the zone from 0 to 12 inches below grade. The excavation area is backfilled with clean fill soil. This alternative will prohibit direct contact with the contaminants.

Construction of a temporary fence will be required around the excavation. Air quality monitoring shall be conducted at the perimeter of the excavation site.

Alternative SS4 - Ex-Situ Treatment; On-site Disposal

Alternative SS4 is similar to alternative SS3, except that the soils are treated to the RAO's of the site and disposal may occur on-site as backfill. Treatment processes may include soil washing, solidification/stabilization, or ex-situ bioremediation.

Soil washing uses water and mechanical action to remove the contaminants that adhere physically to the particles. Surficial contamination is removed from the coarse fraction of the soils by abrasive scouring. The wash water may be augmented with a leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics or heavy metals. The spent wash water requires further treatment, after which it is recycled back to the treatment unit. The contaminated silt/clay fraction also requires further treatment which may consist of solidification/stabilization. Bench scale testing will need to be conducted to verify the efficiency of the option.

Solidification/stabilization consists of excavating the surficial soils and mixing the soils with cement and additives in a conventional concrete mixing plant. The mixture would then be replaced in the ground in 1-foot lifts and finally rolled into compaction. Bench-scale testing should be conducted to evaluate the soil cement concrete. The soil cement should be analyzed for TCLP constituents. Since this option does not reduce the level of contaminants, and requires strict deed controls, disposal would occur at the GE property.

Ex-situ bioremediation involves slot excavation of the soil in strict sequence and may consist of placement of the soil in a treatment facility on-site. The treatment facility may consist a plastic film greenhouse enclosure, a soil treatment bed consisting of an engineered clay liner 12 inches thick and a drainage system to control water movement, a spray system for distributing water, nutrients and inocula, an organic vapor control system consisting of activated carbon absorbers, and a fermentation vessel for preparing microbial inoculum or treating contaminated leachate for the backfill soils. If organic vapors are not a problem, the plastic greenhouse enclosure and the organic vapor control system is not necessary. The contaminated soils would be placed on the treatment bed in approximately 12 to 15 inch lifts, and soil conditions would be optimized for biological activity by daily tilling and by maintenance of the appropriate soil moisture content. The soils during treatment should be sampled weekly and analyzed for residual contamination. Bench scale testing will need to be conducted to verify the efficiency of this option.

Alternative SS5 - Containment

This alternative consists of capping used in conjunction with storm water management and dust control. Capping involves the installation of an impermeable layer over the area of contaminated soil and development of a storm water management system to route storm water off the cap in an acceptable manner. The top foot of contaminated soil at the Shepherd Farm subsite would be excavated and transported to the GE Subsite dry sludge impoundment area. The dry sludge impoundment, Landfill A and Landfill B would be capped as described above. Because portions of Landfills A and B are already paved with asphalt, asphalt is considered the most appropriate capping material. Deed restrictions will be required to limit the use of the site and prevent subsurface development. Annual inspection and maintenance of the containment area will be required.

Alternative GW6a - Ex-Situ Treatment; On-site Discharge

As part of this alternative, the existing extraction well system would be utilized in conjunction with additional extraction wells. Groundwater would be extracted from both the Shepherd Farm Subsite and the GE Subsite. The extracted ground water would be pumped to an on-site treatment facility. The treated ground water would then be discharged to Bat Fork Creek. The process options for treating the VOC's in the ground water include: air stripping, granulated activated carbon (GAC) adsorption or oxidation/UV photolysis. If metals are detected in the effluent at concentrations above the discharge limitations, a process option to remove metals will have to be added into the treatment train. Also, to protect and keep the air stripper functional, the ground water may need filtering prior to treatment.

The existing treatment system is composed of extraction wells, a 10,000-gallon equalization tank, and air stripping tower (currently not present onsite), and associated piping and pumps with discharge to Bat Fork Creek. This is a unit operation in which a volatile component of a solution is transferred into a gas phase. The system used for continuously contacting a liquid and a gas (air) stream may be a tower filled with irregular solid packing material, an empty tower into which the liquid is sprayed, or a tower containing a number of bubble cap or sieve plates. Generally, air and liquid strewns flow counter-currently through the contacting towers in order to achieve the greatest rate of stripping. The efficiency of the air stripping process is mainly dependent on the air-to-water ratio, the contact time, the temperature and the physical and chemical properties of the constituents of concern.

Only one treatment system would be utilized. Groundwater extracted from the Shepherd Farm Subsite would be piped to the treatment system located on the GE Subsite.

Bench and/or pilot studies would have to be conducted to determine if the liquid effluent would have to undergo further treatment prior to discharge. The vapor effluent, off-gas, would have to undergo additional treatment to destroy or remove the contaminants stripped from the ground water prior to being discharged to the atmosphere. The off-gas may be treated by GAC adsorption. The GAC adsorption would consist of down-flow carbon beds connected in series. Pilot studies would have to be performed to determine the optimum feed rates, number of columns and contact time.

The oxidation/UV photolysis process involves the use of ultraviolet light to catalyze the chemical oxidation of organic contaminants in water by its combined effect upon organic contaminant and its reaction with either hydrogen peroxide or ozone. The oxidizer reaction results in the formation of hydroxyl radicals, which then react with organic contaminants in water.

Any sludge generated will have to be tested for TCLP parameters prior to disposal as either a soil or hazardous waste. The spent GAC may be either transported off-site for regeneration at a permitted facility or disposed at a permitted facility. The spent GAC is considered a hazardous waste and is subject to RCRA recycling regulations.

Alternative GW6b - Ex-Situ Treatment; Off-Site Discharge

Alternative GW6b is identical to alternative GW6a, except that the treated ground water would be discharged to the local POTW. Discharge criteria would be set by the POTW.

Alternative GW7a - Groundwater Treatment; Gradient Control; On-Site Disposal

Alternative GW7a consists of both in-situ and ex-situ groundwater treatment, extraction wells, an infiltration gallery, and on-site discharge of treated water. The unit processes involve constructing infiltration trenches on the Shepherd Farm and GE Subsites at appropriate locations which would be used to introduce microorganisms, nutrients and oxygen (if aerobic). This system would require a source of water and a holding/mixing tank for combining the water, nutrients and oxygen source prior to introduction into the aquifer through the infiltration gallery. Extraction wells would be installed around the perimeter of the contaminant plume and in the source areas as well as down gradient of the infiltration trenches. A significant advantage of this alternative is that the extraction wells would provide gradient control. The extracted ground water would be treated in accordance to the ex-situ treatment options presented in Alternative GW6a. The treated water may be discharged either to Bat Fork Creek or used as a source of water in the in-situ treatment of the groundwater.

In-situ bioremediation is used in conjunction with the ex-situ treatment to degrade the contaminants of concern in the aquifer because "conventional" pump and treat methods generally fail to remove the fraction of organic contaminants which are adsorbed to the organic and mineral components of the aquifer matrix. This contaminant fraction may be unrecoverable using standard pumping methods and will continue to slowly solubilize into the ground water.

Bioremediation schemes attempt to either stimulate naturally occurring aerobic or anaerobic microorganisms to degrade contaminants in-situ, or introduce microorganisms capable of degrading the contaminants. Typically, biodegradable contaminants can be degraded at rates which are orders of magnitude greater than the leaching rate of the contaminants in an aquifer system, provided growth limiting nutrients and oxygen are added. Bench testing must be conducted to verify the efficiency of this system and to determine whether aerobic or anaerobic bioremediation would provide the optimum remediation of site contaminants. In addition, deed, permit and zoning restrictions on and near the property may be enacted during the remediation process.

Alternative GW7b - Groundwater Treatment; Gradient Control; Off-Site Disposal

This alternative is similar to alternative GW7a except that the treated water would be discharged to the local POTW.

X. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, each alternative is assessed using seven evaluation criteria required under CERCLA. Comparison of the alternatives with respect to these evaluation criteria are presented in summary form. This approach is designed to provide sufficient information to adequately compare the alternatives, aid in the selection of an appropriate remedy for the site, and demonstrate satisfaction of the statutory requirements upon preparation of the Record of Decision (ROD).

Each alternative is evaluated in terms of its ability to:

- Be protective of human health and the environment.
- Attain ARARs or provide grounds for invoking a waiver.
- Use permanent solutions and alternative treatment technologies or resource

technologies to the maximum extent practicable.

- Satisfy the preference for treatment that reduces toxicity, mobility, or volume of the hazardous substances, pollutants and contaminants as a principal element.

- Be cost-effective.

The seven evaluation criteria required to address the above CERCLA requirements serve as the basis for conducting the detailed analysis. The evaluation criteria are briefly described below.

1. Overall Protection of Human Health and the Environment determines whether each alternative meets the requirement that it be protective of human health and the environment in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants. This criterion is of key importance. While the remedy selected may on occasion seek a waiver of a given ARAR, the remedy selected must be protective of human health and the environment.

2. Compliance with ARARs is used to determine how each alternative complies with federal and state ARARs as defined in CERCLA Section 121, as discussed in Section 3, or provide grounds for invoking one of the waivers.

3. Short-Term Effectiveness addresses the impacts of the alternatives during the construction and implementation phase until remedial response objectives have been met. Alternatives are evaluated with respect to their short-term effects on human health and the environment.

4. Long-Term Effectiveness and Permanence addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the effectiveness of the controls that will be applied to manage risk posed by treatment residuals or untreated wastes.

5. Reduction of Toxicity, Mobility, and Volume addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substance as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

6. Implementability addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

7. Cost estimates for the FS are expected to provide an order-of-magnitude evaluation for comparison of alternatives and are based on the site characterization developed in the Ri. Capital cost, annual cost, and a present worth analysis are part of this evaluation. The present worth represents the amount of money that, if invested in the initial year of the remedial action at a given rate, would provide the funds required to make future payments to cover all costs associated with the remedial action over its planned life. The baseline present worth is computed at a discount (interest) rate of 7 percent over a 30 year period. Appendix A contains spreadsheets showing each component of the present worth costs.

The first two criteria are referred to in the RI/FS guidance manual (EPA 1988) as the "threshold factors", implying that for further consideration of an alternative, these two criteria must be satisfied. Alternatives which do not satisfy these threshold factors are not feasible (40 CFR 300.430(f)(1)(I)(A). Criteria 3 through 7 are referred to as "primary balancing factors" (page 4-25 of RI/FS manual), implying that these criteria are used to select the alternative among the feasible alternatives. Criteria 3 through 5, however, are also measures of the effectiveness and are used accordingly. There are two other criteria, state acceptance and community acceptance, which are provided by state and local agencies and the public. These criteria will be evaluated in the responsiveness summary. A detailed evaluation of the alternatives using the above criteria is presented below.

Alternative 1 - No Action

Section 300.430 (e) of the NCP requires that the "no action" alternative be carried forward for consideration in the detailed analysis of alternatives as a baseline for comparison of the other alternatives. Under the no action alternative, funds are not expended for control or cleanup of surface soil or ground-water contamination associated with the GE Site.

Overall Protection of Human Health and the Environment

This Alternative would not provide any increased protection to human health or the environment. If no action is taken, contaminants in the source areas would remain and continue to leach into ground water. No remediation efforts have been conducted in the two landfill areas at the GE site or the Shepherd Farm property, both of which are contaminated with PCB's. These contaminants would not be expected to decrease significantly with time due to the very slow rate of degradation. GE reports that all USTs and contaminated soils associated with the USTs have been removed, as well as all of the soils associated with the ruptured drain line. Since these are suspected to be the main sources associated with the VOC contamination in the groundwater and they have been removed, the concentration of contaminants in the ground water would continue to decrease with time due to natural attenuation and degradation. However under this action monitoring of the decrease would be conducted at the 5-year review stage.

Compliance with ARARs

The "no action" alternative would not address compliance with ARARs since there would be no active measures taken to reduce the contaminant concentrations. The volatile contaminant concentrations would be expected to decrease with time due to natural attenuation and degradation. Location- and action- specific ARARs do not apply to this alternative since further remedial actions would not be conducted.

Short-Term Effectiveness

Because no activities would be implemented, there would be no additional impact on the community. Also, no construction or operation related impacts to the environment would occur, since no site activities would be performed.

Long-Term Effectiveness and Permanence

Because remedial actions would not occur, this alternative would not provide any long-term effectiveness or permanence. The long term risks of exposure of on-site receptors to the contaminated surface soils and ground water would not be addressed. However, since the suspect sources Of ground water contamination have been removed, the concentration of contaminants in the ground water would be expected to decrease with time due to natural attenuation and degradation. The areas contaminated with PCB's would not be expected to decrease significantly with time due to the very slow rate of degradation.

Reduction of Toxicity, Mobility, and Volume

The "no action" alternative would provide no reduction in toxicity, mobility, or volume of contaminated media.

Implementability

This criterion is not applicable because remedial activities would not occur.

Cost

The cost of this alternative consists only of 5-year review expenses. The total present worth cost for this alternative is approximately $160,211. The estimated annual operation and maintenance cost is approximately $21,800. Total capital costs are estimated to be $0.

Alternative 2 - Institutional Action

This alternative includes access restrictions and monitoring to protect human health and the environment. Under this alternative, no source control remedial measures will be undertaken at the GE site. Five-year reviews are required under the NCP to determine if contaminants which remain on-site are causing additional risk to human health or the environment. As a result of this review, EPA will determine if additional site remediation is required. Five-year reviews are assumed to be conducted for a 30-year period.

Overall Protection of Human Health and the Environment

Institutional controls would limit exposure to on-site soils by restricting access; however, the restrictions would not eliminate the risk of exposure or control the plume migration. Consequently, this alternative would not provide active protection of human health and the environment, although monitoring would reveal future threats to human health and the environment.

Compliance with ARARs

This alternative does not achieve the remedial action objectives or chemical-specific ARARs established for surface soil and groundwater. Through natural attenuation and degradation, a decrease in the contaminant concentration would be expected with time. However, the magnitude of the decrease can only be qualitatively determined. It is not known whether natural attenuation and degradation would result in sufficient contaminant reduction to attain ARAR's. Location- and action-specific ARARs do not apply to this alternative since further remedial actions of an intrusive nature would not be conducted.

Short-Term Effectiveness

Institutional controls could be implemented in approximately one year. Ground water and soil monitoring could begin immediately. No significant environmental impacts would be expected during the sampling events. The surrounding community and workers would be protected by restricted access to the contaminated media, provided the restrictions are complied with.

Long-Term Effectiveness and Permanence

Properly implemented institutional controls would prevent ingestion and direct contact with contaminated media, thereby reducing risk to potential users. Implementation of institutional controls with continued monitoring would be required indefinitely. The long term monitoring results and the actual effectiveness of the institutional controls would require periodic reassessment to determine the continued effectiveness of this alternative. If the degree of protectiveness to human health is insufficient, further remedial actions would have to be implemented.

Reduction of Toxicity, Mobility, and Volume

This alternative would not actively reduce the volume, toxicity or mobility of the contaminants of concern. The size of the contaminant plume could increase with time. However, as the size of the plume increases, the contaminant concentrations would decrease via natural attenuation and degradation.

Implementability

This alternative would be readily implemented since there are no remedial activities of an intrusive nature being performed. The implementation of monitoring would present no difficulties. Implementing and enforcing deed restrictions would require the cooperation of the state and county governments. Institutional controls are subject to change in legal and political interpretations over time. The attachment of deed restrictions to the GE Subsite can be readily implemented. Voluntary acceptance by adjacent property owners is questionable. Consequently, present or future property owners could choose to ignore or be unaware of the use restrictions. The restrictions could also be lost during future property transfers. For the above reasons, the reliability of ground water use restrictions is considered uncertain. Legal services, field personnel and analytical laboratories necessary for implementation of this alternative are readily available. If additional monitor wells are required, well drilling services are readily available. Monitor equipment is readily available for groundwater sampling. Long-term maintenance and possible future replacement of the fence and signs would be required but also could be implemented with some ease.

Cost

The total cost for this alternative consists of deed restrictions, permit restrictions, and ground-water monitoring only; no treatment is included. The total present worth cost for this alternative is approximately $346,362. The estimated annual operation and maintenance cost is approximately $24,300. Total capital costs are estimated to be $100,750.

Alternative SS3 - Excavation; Off-Site Disposal

This treatment alternative involves excavating the contaminated surficial soils which exceed the Remediation Goals and disposal in a RCRA Subtitle D Municipal Solid Waste Landfill. The excavation is backfilled with clean fill soil, and the area is revegetated.

Overall Protection of Human Health and the Environment

This alternative would provide increased protection of human health and the environment through the removal of the organic chemicals which exceed EPA's Remediation Goals. This alternative will virtually eliminate the risks associated with the exposure pathways and greatly reduce the potential risk of surface soil ingestion, inhalation, and dermal contact.

Compliance with ARARs

This alternative will comply with the chemical-, location- and action-specific ARARs.

Short-Term Effectiveness

Achievement of short-term effectiveness will require special construction procedures and controls to ensure that human health and the environment are adequately protected during the excavation operation. The primary exposure route is through dust emissions. Air monitoring will be necessary to ensure that a safe working environment is maintained and that no threat to human health and the environment is created by air emissions. However, direct exposure can also occur during loading, hauling and disposal. Also, impact due to noise, truck traffic, and other activities will have to be controlled. This exposure and impact can be limited as the alternative is highly utilized and well proven.

Long-Term Effectiveness and Permanence

This alternative is completely effective because it provides for removal of contaminated soil such that the Remediation goals are met for surface soils. The removed soils will be disposed of off site and replaced with clean backfill.

Reduction of Toxicity, Mobility, and Volume

Contaminated surface soil will be excavated and disposed of in a Subtitle D Municipal Solid Waste Landfill. Off-site landfill disposal will reduce the mobility of contaminants, but the volume and toxicity remain the same.

Implementability

As with short-term effectiveness, this technology has been demonstrated to be readily implementable because it utilizes well proven equipment and construction methods, providing it is well planned and supervised.

An estimated four months will be required for contractor selection. The actual implementation of the alternative, including site preparation and excavation, may take an additional two months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately six months.

An engineering consideration for the excavation and off-site disposal of the contaminated surface soil is that all permits and licenses must be obtained and/or validated before off-site transport.

The major system components, construction equipment, and materials required for operations under this alternative include

- contractor's temporary facilities and utilities;
- bulldozer;
- backhoe;
- front-end loader;
- dump trucks with liners and tarps for transportation of soil;
- backfill for excavated areas; and
- hydroseeding equipment.

Cost

The total present worth cost for this alternative is approximately $1,524,235. The estimated annual operation and maintenance cost is approximately $0. Total capital costs are estimated to be $1,524,235.

Alternative SS4 - Ex-Situ-Treatment; On Site Disposal

This alternative consists of excavation and treatment of contaminated soils to the RAO's of the site and disposal on-site as backfill.

Overall Protection of Human Heath and the Environment

This alternative would provide an increased protection of human health and the environment through excavation and treatment of the contaminated surface soils, and will eliminate the risks associated with the exposure pathways.

Compliance with ARARs

This alternative will comply the chemical-, location- and action-specific ARARs.

Short-Term Effectiveness

Achievement of short-term effectiveness will require special construction procedures and controls to ensure that human health and the environment are adequately protected during the excavation operation. The primary exposure route is through dust emissions. However, direct exposure can also occur during loading, hauling and disposal. In addition, impact due to noise, truck traffic, and other activities will have to be controlled.

Long-Term Effectiveness and Permanence

This alternative is completely effective because it provides for excavation and treatment of contaminated soil. If the soil is treated such that the RAO's are achieved, then the soil will be suitable for backfill.

Reduction of Toxicity, Mobility, and Volume

The alternative reduces the mobility and toxicity of soil contamination at the site through on-site treatment. The volume also will be reduced unless solidification/stabilization is part of the treatment process. In this case, the volume of the treated material may increase depending on the type of stabilizer used.

Implementability

The bench-scale studies of the treatment system will require approximately three months and the design of the treatment system will require approximately three months. An estimated six months will be required for contractor selection. The actual excavation and treatment of contaminated surface soil may take another six months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately 1.5 years.

The major engineering considerations in implementing the excavation and on-site treatment system include

- design of soil staging area;
- bench-scale testing; and
- design and installation of treatment option.

The major system components, construction equipment, and materials required for operations under this alternative include

- contractor's temporary facilities and utilities;
- bulldozer;
- backhoe;
- front-end loader;
- dump trucks;
- treatment units;
- backfill for excavated (if necessary); and
- hydroseeding equipment.

Monitoring the operation of the treatment system would be required to verify that the treated soil meets the anticipated remediation goals. Determination of the soil leaching potential by TCLP testing would be required before on-site disposal for compliance with RCRA and state regulations.

Cost

The total present worth cost for the solidification/stabilization option in this alternative is approximately $3,040,287. The estimated annual operation and maintenance cost is approximately $118,400. Total capital costs are estimated to be $2,288,472. Detailed cost estimates are presented in Appendix A.

The total present worth cost for soil washing option in this alternative is approximately $4,174,375. The estimated annual operation and maintenance cost is approximately $118,400. Total capital costs are estimated to be $3,422,560. Detailed cost estimates are presented in Appendix A.

The total present worth cost for the bioremediation option in this alternative is approximately $1,955,437. The estimated annual operation and maintenance cost is approximately $118,400. Total capital costs are estimated to be $1,203,622. Detailed cost estimates are present in Appendix A.

Alternative SS5 - Containment

The primary objective of this alternative is to eliminate the mobility and exposure pathways of site chemicals by containment. Containment is achieved by capping. A storm water management system will be required to reduce surface water impacts. Short term dust and vapor controls will be required during construction activities. This alternative also includes monitoring and access restrictions.

Overall Protection of Human Health and the Environment

This alternative results in protection of human health and the environment by preventing direct exposure to impacted soils and by preventing off-site migration of chemicals in the surface soils.

Compliance with ARARs

This alternative will meet site-specific ARARs because this alternative will prevent direct contact
with the soils.

Short-Term Effectiveness

Achievement of short-term effectiveness will require special construction procedures and controls to ensure that human health and the environment are adequately protected during the construction operations. The primary exposure route is through dust emissions. However, direct exposure can also occur during loading, hauling and disposal. Also, impact due to noise, truck traffic, and other activities will have to be controlled. This exposure and impact can be limited as the alternative is highly utilized and well proven.

Long-Term Effectiveness and Permanence

This alternative requires regular maintenance and continued implementation of access restriction to assure long-term effectiveness. Capping does not provide an ultimate permanent remedy but should be considered of long duration for comparative purposes. Since contaminated soil remains on-site 5-year reviews over an estimated 30-year period would be required to ensure that this alternative provides adequate protection of human health and the environment under CERCLA 121(c).

Reduction of Toxicity, Mobility, and Volume

This alternative eliminates migration of constituents from the site area and thus reduces the mobility of site chemicals. The toxicity and volume of the impacted source soil will essentially remain unchanged.

Implementability

An estimated three months will be required for contractor selection. The actual implementation of the alternative, including site preparation and construction of the cap, may take another three months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately six months. This alternative could take more time to implement if it is difficult to obtain the necessary deed restrictions.

The major engineering considerations for capping include

- design of stormwater collection system;
- anticipated service life of the cap;
- cap thickness and infiltration potential;
- replacement schedule; and
- effects of environmental factors on the cap.

The major system components, construction equipment, and materials required for operations under this alternative include

- contractor's temporary facilities and utilities;
- asphalt;
- backhoe;
- bulldozer;
- front-end loader;
- dump trucks with liners and tarps for transportation of soil;
- backfill for excavated areas; and
- hydroseeding equipment.

The cap would be inspected on a regular basis for signs of erosion, settlement, or subsidence. Institutional controls consisting of deed restrictions to protect the integrity of the cap system, and long-term groundwater monitoring would apply.

Cost

The total present worth cost for this alternative is approximately $855,297. The estimated annual operation and maintenance cost is approximately $6,200. Total capital costs are estimated to be $777,426.

Alternative GW6a - Ex-Situ Treatment; On-Site Discharge

This alternative involves using the existing extraction well system. The extracted ground water would be pumped to an on-site treatment facility. The treated ground water would then be discharged to Bat Fork Creek. The operation of the ground water extraction and treatment system would continue until the remedial action objectives are achieved.

Overall Protection of Human Health and the Environment

As long as the groundwater extraction system is in operation, this alternative will eliminate the exposure pathways and greatly reduce the potential risk of groundwater ingestion and inhalation of volatiles. Additionally, contaminated groundwater will be contained so that downgradient wells would not become contaminated through continued migration of contaminants. However, if groundwater extraction is halted before remediation goals are obtained, contaminated groundwater will no longer be contained, and exposure pathways associated with continued contaminant migration in groundwater may emerge again.

Compliance with ARARs

Groundwater extraction will act to decrease contaminant concentrations in groundwater by removing contaminants from the aquifer system, and is thus potentially effective in achieving chemical-specific ARARs within a reasonable timeframe. Air quality and emission standards will have to be met since there will be an on-site treatment system. The treated water needs to meet all effluent requirements and ambient water quality criteria before discharge to Bat Fork Creek. Location-specific ARARs will have to be considered during the remedial design, particularly with regard to the installation of the treatment system. Specifically, citing of the treatment system will be in an area that is protective of the wetlands and outside of the 100-year floodplain. Significant habitats will have to be identified and the presence of endangered species needs to be confirmed before any remedial action takes place. Specifically, the bunched arrowhead plant, which has been as an endangered plant and is located near the site, will have to be protected during extraction of groundwater. In addition, the impacts on the East Flat Rock Bog remnant in the GE site vicinity and the King Creek Bog in the Shepherd Farm Site vicinity need to be considered. These bogs have been identified as priority areas of national significance and also may be negatively impacted by groundwater extraction. Action-specific ARARs also will have to be considered, including discharge to a surface water body.

Short-Term Effectiveness

Construction operations associated with this remedial alternative would produce limited disturbance to the surrounding community. All treatment facilities would be located on the GE site within the fenced area. Proper operation of the treatment system would result in no atmospheric discharges VOC's. An effluent discharge monitoring station for treated ground water would provide a check on the effluent quality prior to discharge. Continued monitoring of the ground water would provide a check on the plume movement and provide evidence of progress in attaining remedial goals.

Long-Term Effectiveness and Permanence

The long term effectiveness and permanence of this alternative depends on the effectiveness of the ground water extraction mechanism in removing the contamination from the aquifer.

Contaminants of concern adsorbed to the aquifer matrix and released very slowly could result in the inability of this alternative to achieve the remedial goals. The major long term control required to remediate the ground water will be the continued operation and maintenance of the extraction well(s) and the treatment system. The operation and maintenance of the well(s) and treatment will include repair/replacement of pumps and piping, purchase of chemicals, regeneration of GAC and replacement of UV bulbs. Long term monitoring of the ground water would be effective in tracking the nature and extent of contamination and the effectiveness of the treatment unit. Sampling the existing monitor well network would indicate if contaminants are migrating from the extraction capture zone. Long term controls would be limited to continued ground water monitoring.

Reduction of Toxicity, Mobility, and Volume

The various unit processes in the treatment system will provide for the degradation or destruction of a significant portion of all of the contamination in the ground water. Using conventional ground water extraction methods, a portion of the contaminants of concern will remain adsorbed to the organic and mineral components of the aquifer matrix after pumping for long periods of time. These contaminants will tend to slowly solubilize back into the ground water indefinitely. However, the majority of the plume could be captured for treatment. The ground water would be treated to achieve the MCL's for the contaminants of concern.

Implementability

This system could easily be implemented on the site. The unit processes of the treatment system are commercially available and have been demonstrated to be effective on the contaminants of concern. Pilot scale treatability studies would be required to develop specific design parameters and confirm the systems effectiveness in treating the contaminants of concern. It is anticipated that the existing system would be incorporated into the design.

The administrative requirements for this alternative are minimal; these include compliance with technical NPDES requirements, established by EPA and North Carolina, for discharge of treated ground water on site. The unit process for the treatment system, and required contractors and equipment are readily available. Prior to development of the extraction system, additional aquifer testing would be required to fully characterize the aquifer. Aquifer modeling would also be required to determine locations and depths of any additional wells needed, and the most effective pumping rates.

An estimated six to nine months will be required for design and contractor selection. The actual implementation of the alternative, including site preparation and installation of any additional components to the existing treatment system (i.e., air stripper), may take another three months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately 1 year.

The major engineering considerations in implementing the groundwater and discharge systems include

- testing of the existing extraction well system;
- potential for well plugging (reduction in flows) over time;
- monitoring requirements;
- cleanup verification;
- piping of extracted water to the treatment system;
- piping of treated water to Bat Fork Creek; and
- NPDES permit requirements.

The major engineering considerations in implementing the groundwater treatment system include

- design flow;
- permit requirements;
- pilot studies for treatment processes;
- citing and design of treatment units;
- monitoring the effluent water quality for surface water discharge;
- implementing treatment option for offgas from the air stripper;
- monitoring the effluent air quality from the air stripper; and
- process effectiveness monitoring.

The major system components, construction equipment, and materials required for operations under this alternative include

- contractor's temporary facilities and utilities;
- additional process units for the existing groundwater treatment system;
- pumping, piping, fittings, and valves for fluids transport; and
- system instrumentation and controls.

Long-term groundwater monitoring for cleanup verification purposes and to track contaminant plume migration would be required under this alternative. Samples would be collected from selected existing wells and analyzed for the site indicator parameters.

The groundwater treatment system also would require monitoring and maintenance during its approximate 30-year operational life. Monitoring of the treatment system would include periodic sampling of the influent and effluent from the treatment system and analysis in accordance with NPDES discharge permit requirements. Sample collection is assumed to be on a weekly basis.

Maintenance of the extraction and treatment systems would be performed in accordance with operation and maintenance requirements developed after equipment specification and procurement are completed. At a minimum, it is expected that regular periodic maintenance would be required on the submersible pumps, valves, and fittings of fluids piping systems, as well as on the treatment system to ensure its efficient operation.

Operation and maintenance of the treatment system would be conducted by a contractor who would be responsible for continuous operation and maintenance of the process. Process control would be automated as much as possible with the contractor stopping by periodically to checkup on the system.

Cost

The total present worth cost for this alternative is approximately $5,328,398. The estimated annual operation and maintenance cost is approximately $273,285. Total capital costs are estimated to be $1,166,750.

Alternative GW6b - Ex-Situ Treatment; Off-site Discharge

Alternative GW6b is identical to alternative GW6a, except that the treated ground water would be discharged to the local POTW.

Overall Protection of Human Health and the Environment

This alternative would provide increased protection of human health and the environment through extraction and treatment of contaminated ground water.

Compliance with ARARs

This alternative is expected to comply with all ARARs. The ground water would have to be treated to the POTW permit requirements.

Short-Term Effectiveness

The short term effectiveness of this alternative is similar to alternative GW6a. Minimal disturbance is expected.

Long-Term Effectiveness and Permanence

This alternative would provide the same degree of long term effectiveness and permanence as alternative GW6a. Long term controls would be limited to continued ground water monitoring.

Reduction of Toxicity, Mobility, and Volume

This alternative would provide the same reduction of toxicity and volume as alternative GW6a.

Implementability

The implementability of this alternative would be the same as alternative GW6a.

Cost

The total present worth cost for this alternative is approximately $6,076,336. The estimated annual operation and maintenance cost is approximately $295,085. Total capital costs are estimated to be $1,166,750.

Alternative GW7a - Ground-water Treatment; Gradient Control; On Site Discharge

Alternative GW7a involves the use of in-situ bioremediation to degrade the contaminants of concern in the aquifer. The process involves installing up gradient infiltration trenches at an appropriate location which would be used to introduce microorganisms, nutrients and an oxygen source (if aerobic). This system would require an external source of water and a holding/mixing tank for combining the water, nutrients and oxygen source prior to infiltration into the aquifer.

Overall Protection of Human Health and the Environment

This alternative would provide significant protection of human health and the environment through expedited ground water remediation (as compared to pump and treat). No adverse health effects are anticipated to result from the growth of indigenous microorganisms under this alternative. In fact, after active remediation is ceased, microorganisms would be available to degrade any residual contamination in the aquifer.

Compliance with ARARs

The in-situ bioremediation process would be designed to meet the remedial goals for the GE site and the process would be continued until the goals were attained.

Short-Term Effectiveness

Short term risks would be similar to those discussed for the two previous remedial alternatives.

No adverse environmental impacts are anticipated.

Long-Term Effectiveness and Permanence

This alternative would be effective in achieving permanent remediation of the contaminated ground water plume. Any residual contamination remaining after cessation of active remediation would continue to be degraded until the contaminant, oxygen and nutrient supply is depleted. Long term controls would be limited to continued ground water monitoring.

Reduction of Toxicity, Mobility, and Volume

The in-situ bioremediation technology used in this alternative would be effective in permanently reducing the mobility, toxicity and volume of contamination. The concentration of contaminants would be reduced to enforceable drinking water standards. With the reduction of contaminant concentrations, the volume of the plume would decrease throughout the removal action.

Implementability

The technical feasibility of enhanced bioremediation of VOC's is documented in full-scale remediation projects and field treatability studies. In-situ bioremediation is most successful at sites with moderate to high permeability and a shallow zone of contamination. Prior to development of the infiltration system, additional aquifer tests would be required to fully characterize the aquifer and to determine the most effective infiltration rates.

An estimated six to nine months will be required for design and contractor selection. The actual implementation of the alternative, including site preparation, construction of the infiltration trenches, and installation of the mixing system, may take another three months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately 1 year.

The major engineering considerations in implementing the in-situ groundwater treatment system include

- pilot study for biotreatment process;
- citing and design of the mixing system and infiltration trenches;
- monitoring the effluent water quality from the mixing tank before discharging to trenches;
- process effectiveness monitoring; and
- cleanup verification.

The major components, construction equipment, and materials required for operations under this alternative include

- contractor's temporary facilities and utilities;
- process unit for the in-situ groundwater treatment system (i.e, mixing tank and nutrients);
- water source for the mixing system; and
- system instrumentation and controls.

Long-term groundwater monitoring for cleanup verification purposes and to track contaminant plume migration would be required under this alternative. Samples would be collected from selected existing wells and analyzed for the site indicator parameters.

The in-situ groundwater treatment system also would require monitoring, with possible maintenance of the mixing system, during its approximate 15-year operational life. Monitoring of the treatment system may include periodic sampling of the levels of microorganisms, nutrients, and oxygen that are being added before infiltration into the aquifer.

Maintenance of the biotreatment system would be performed in accordance with operation and maintenance requirements developed after equipment specification and procurement are completed. At a minimum, it is expected that regular periodic maintenance would be required on the mixing system to ensure its efficient operation.

Operation and maintenance of the in-situ treatment system would be conducted by a contractor who would be responsible for continuous operation and maintenance of the process. Process control would be automated as much as possible with the contractor stopping by periodically to checkup the system.

Cost

The total present worth cost for this alternative is approximately $4,578,440. The estimated annual operation and maintenance cost is approximately $309,285. Total capital costs are estimated to be $1,378,000.

Alternative GW7b - Groundwater Treatment; Gradient Control; Off-Site Discharge

This alternative is identical to Alternative GW7a, except that the treated groundwater would be discharged to the local POTW.

Overall Protection of Human Health and the Environment

This alternative would provide the same overall protection of human health and the environment as Alternative GW7A.

Compliance with ARARs

The in-situ bioremediation process would be designed to meet the remedial goals for the GE Site and the process would be continued until the goals were attained.

Short-Term Effectiveness

As with alternative GW7a, the short term risks would be similar to those discussed for remedial alternative GW6a. No adverse environmental impacts are anticipated.

Long-Term Effectiveness and Permanence

This alternative would provide the same degree of long term effectiveness and permanence as alternative GW7A.

Reduction of Toxicity, Mobility and Volume

This alternative would provide the same reduction of toxicity, mobility, and volume as Alternative GW7a.

Implementability

An estimated nine months will be required for design and contractor selection. The actual implementation of the alternative, including site preparation, construction of the infiltration trenches, installation of extraction wells, installation of the mixing system, and installation of the ex-situ treatment system, may take another six months. Therefore, assuming that weather conditions do not cause extreme delays, this alternative could be implemented in approximately 1.5 years.

The major engineering considerations in implementing the gradient control system and the in-situ and ex-situ treatment include

- citing, design, installation, and testing of extraction wells for gradient control;
- potential for well plugging (reduction in flows) over time;
- piping of extracted water to the mixing system and ex-situ treatment system;
- monitoring the extracted water quality for possible treatment before use in mixing system;
- pilot study for biotreatment process;
- pilot study for ex-situ treatment processes;
- citing and design of the mixing system, infiltration trenches, and ex-situ system;
- process effectiveness monitoring; and
- cleanup verification.

The major system components, construction equipment, and materials required for operations under this alternative include

- contractor's facilities and utilities;
- wells and submersible groundwater pumps;
- pumping, piping, fittings, and valves for fluids transport;
- process unit for the in-situ groundwater treatment system (i.e, mixing tank and nutrients);
- process unit for the ex-situ groundwater treatment system, if necessary; and
- system instrumentation and controls.

Cost

The total present worth cost for this alternative is approximately $4,969,250. The estimated annual operation and maintenance cost is approximately $345,285. Total capital costs are estimated to be $1,378,000.

Comparative Analysis of Alternatives

Presented in Table 24 is ranking scores for each non-cost evaluation criteria. Each alternative's performance was ranked on a scale of zero to five, with zero indicating none of the criteria's requirements were met, and five indicating all of the requirements were met. The ranking scores are not intended to be quantitative or additive. They are summary indicators only of each alternatives performance against the non-cost evaluation criteria. The ranking scores combined with the present worth costs provide the basis for comparison among alternatives.

Under overall protection, the no action alternative (Alternative 1) is ranked the lowest ("0") since contaminated soil and groundwater are left on-site with no further actions being conducted. Alternative 2 is ranked slightly higher ("1") since deed restrictions and fencing would be implemented to limit contact with the contaminated soil and groundwater. Alternative SS5 is ranked higher ("3") than Alternative 2 since contaminated soil at the GE Site would be capped, thus reducing migration of contaminants via rainfall infiltration. The remaining alternatives (SS3 and SS4; GW6a through GW7b) are ranked the highest ("5") since contaminated soil and groundwater are being either removed, treated, and/or disposed.

Under compliance with ARARs, Alternatives 1 and 2 are ranked the lowest ("0") since contaminated soil and groundwater remain on-site and chemical-specific ARARs are not met. Alternative SS5 is only slightly lower than the removal and treatment alternatives; however, ARARs are still met. Alternatives SS3 and SS4 are ranked high ("5") since contaminated soil is being removed and either disposed off-site or treated on-site with backfill of treated material on-site. Alternatives GW6a and GW6b and ranked slightly lower ("4") than Alternatives GW7a and GW7b ("5") since pump-and treat may not be as effective as in-situ treatment in remediating groundwater.

Under long-term effectiveness, the no action alternative (Alternative 1) is ranked the lowest ("0") since contaminated soil and groundwater are left on-site with no further actions being conducted. Alternative 2 is ranked slightly higher ("1") since deed restrictions and fencing would be implemented to limit contact with the contaminated soil and groundwater. Alternative SS5 is ranked higher ("3") than Alternative 2 since contaminated soil at the GE Site would be capped, thus reducing migration of contaminants via rainfall infiltration. Alternatives GW6a and GW6b and ranked slightly lower ("4") than Alternatives GW7a and GW7b ("5") since pump-and treat may not be as effective as in-situ treatment in remediating groundwater.

Table 24
COMPARATIVE ANALYSIS OF ALTERNATIVES
GE/SHEPHERD FARM NPL SITE

Remedial Alternative	Criteria Rating(a)						
	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of M/T/V Through Treatment	Short-Term Effectiveness	Implementability	Present Worth
1 - No Action	0	0	0	0	5	5	$160,211
2 - Institutional Actions	1	1	1	0	4	4	$346,362
SS3 - Excavation; Off-site Disposal	5	5	5	4	3	4	$1,524,235
SS4 - Ex-situ Treatment; On-site Disposal	5	5	5	4	3	3	SW - $4,174,375 S/S - $3,040,287 BIO - $1,955,437
SS5 - Containment	4	4	3	3	3	3	$855,297
GW6a - Ex-situ Treatment; On-site Discharge	5	4	4	4	3	3	$5,328,398
GW6b - Ex-situ Treatment; Off-site Discharge	5	4	4	4	3	3	$6,076,336
GW7a - Groundwater Treatment; On-Site Discharge	5	5	5	5	3	3	$4,578,440
GW7b - Groundwater Treatment; Off-Site Discharge	5	5	5	5	3	3	$4,969,250

(a) A ranking of "0" indicates noncompliance while a ranking of "5" indicates complete compliance.

SW - SOIL WASHING
S/S - SOLIDIFICATION/STABILIZATION
BIO - BIOREMEDIATION

Under reduction of M/T/V, Alternatives 1 and 2 are ranked the lowest ("0") since contaminated soil and groundwater remain on-site. Alternative SS5 is only slightly better in that an asphalt cap would be placed at the GE Site; thus, mobility is reduced. Alternative SS3 is ranked slightly higher ("4") since contaminated soil is being removed and disposed off-site. Therefore, mobility is eliminated; however, volume and toxicity remain the same. Alternative SS4 is ranked the same as SS3 since soil is removed and treated on-site before being placed back on-site. Note that the volume may increase, however, due to solidification. Alternatives GW6a and GW6b and ranked slightly lower ("4") than Alternatives GW7a and GW7b ("5") since pump-and treat may not be as effective as in-situ treatment in remediating groundwater.

Under short-term effectiveness and implementability, Alternative 1 is ranked the highest ("5") since no further action are being conducted. Alternative 2 is ranked next ("4") since the only action taking place is monitoring, deed restrictions, and maintaining the perimeter fence. The remaining alternatives are ranked at a "3".

XI. THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, EPA has selected both a source control and groundwater remedy for this Site. At the completion of this remedy, the risk associated with this Site has been calculated to be within the accepted risk range determined to be protective of human health and the environment. The total present worth of the selected remedy for soils ($855,297), and Alternative GW7A for groundwater ($4,578,440), is estimated at $5,433,737. See Tables 25 and 26 for the detailed cost estimates of these chosen alternatives.

Remediation will not he conducted at the Seldon Clark Subsite. Soil and groundwater were below the remediation goals for the Site.

A. SOURCE CONTROL

Source Control remediation will address the contaminated soils and materials at the Site. The GE source control remedy requires that the soils contaminated above the remediation levels on the GE Subsite be covered with an impermeable cap. The cap will be a composite liner and shall consist of 18 inches of clay, a flexible membrane liner, and if necessary, a drainage layer. A storm water management system will be developed to route storm water away from the cap and to prevent any negative impacts from water runoffs. The integrity of the cap will be maintained and inspected on a regular basis for signs of erosion, settlement, or subsidence. Deed restrictions will be required to limit the use of the areas and to prevent subsurface development.

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Table Number: 26 **PRESENT WORTH COST**

Alternative No: GW7A - Groundwater Treatment; On-Site Discharge
Site Name: GE/Shepherd Farm **Discount Rate: 7%**
Site Location: Concord, NC **Date: 07/95**

ITEM DESCRIPTION	UNITS	QUANTITY	UNIT PRICE DOLLARS	TOTAL COST DOLLARS
MOBILIZATION				
Transport Equipment/Staff	each	1	$10,000	$10,000
Temporary Facilities	each	1	$10,000	$10,000
GROUNDWATER EXTRACTION				
Extraction Well Installation	well	5	$2,500	$12,500
Submersible Pumps	each	5	$1,000	$5,000
Pipes, Valves & Fittings	ft	10,000	$15	$150,000
Aquifer Testing	LS	1	$20,000	$20,000
WATER TREATMENT FACILITY				
Site Preparation	acre	0.5	$3,000	$1,500
Earthwork	cy	500	$15	$7,500
Treatment Facility	sqft	1,600	$80	$128,437
Lighting/HVAC System	LS	1	$15,000	$15,000
WATER TREATMENT PROCESS				
Equalization/Holding Tank	each	1	$10,000	$10,000
Air Stripping Unit	LS	1	$150,000	$150,000
Equipment Installation	LS	1	50,000	$50,000
Transfer Pumps	each	2	6,000	$6,000
Control Panel & Instrumentation	LS	1	$30,000	$30,000
Pipes, Valves, & Appurtenances	LS	1	$60,000	$60,000
GAC Unit	unit	1	$5,000	$5,000
WATER DISCHARGE TO SW				
Pumps (Installed)	each	2	$2,500	$5,000
Pipes, Valves, & Fittings	ft	500	$25	$12,500
EQUIPMENT & MATERIALS				
Health & Safety Equipment and Temporary Utilities	LS	1	$30,000	$30,000
BIOREMEDIATION				
Treatability Study	LS	1	$50,000	$50,000
Reinfiltration System	LS	1	$80,000	$80,000
Subtotal - Capital Cost				$848,000
Contractor Fee (10% of Capital Cost)				$84,000
Legal Fees, Licenses & Permits (5% of Capital Cost)				$42,400
Engineering & Administrative (15% of Capital Cost)				$127,200
Subtotal				$1,102,400
Contingency (25% of Subtotal)				$275,600
TOTAL CONSTRUCTION COST				$1,378,000
PRESENT WORTH O&M COST				$3,200,440
TOTAL PRESENT WORTH COST				$4,578,440

Table Number: 26 (CON'T) **OPERATION AND MAINTENANCE COST**
Alternative No: GW7A; Groundwater Treatment; On-Site Discharge
Site Name: GE/Shepherd Farm **Discount Rate: 7%**
Site Location: East Flat Rock, NC **Date: 07/95**

ITEM DESCRIPTION	UNITS	AMOUNT	UNIT PRICE DOLLARS	TOTAL ANNUAL COST, DOLLARS	OPERATION TIME, YEARS	PRESENT WORTH
Power	month	12	$500	$6,000	15	$5,628
Maintenance/Repair	month	12	$2,500	$30,000	15	$278,139
Operating Labor	hr	2,190	$50	$109,500	15	$1,001,300
Stripper Packing Media	LS	1	$5,000	$5,000	15	$71,612
Carbon Replacement	lb	500	$1.70	$850	15	$12,175
Disposal Spent Carbon	lb	500	$1.35	$675	15	$9,668
SW DISCHARGE MONITORING						
Personnel	hr	96	$50	$4,800	15	$44,500
Supplies	days	12	$180	$2,160	15	$20,025
Monthly Sampling	each	12	$500	$8,500	15	$55,628
SHORT-TERM MONITORING						
Personnel	hr	64	$50	$3,200	5	$15,725
Supplies	days	8	$3,000	$24,000	5	$117,930
Quarterly Well Sampling (20 wells)	well	80	$500	$40,000	5	$196,547
LONG-TERM MONITORING						
Personnel	hr	32	$50	$1,600	10	$22,909
Supplies	days	4	$3,000	$12,000	10	$116,238
Semi-Annual Sampling	well	40	$500	$20,000	10	$193,730
5-Year Report Prep	LS	1	$5,000	$5,000	3	$14,830
BIOREMEDIATION						
Additives	month	12	$2,500	$30,000	15	$278,140
System Maintenance	month	12	$500	$6,000	15	$55,628
SUBTOTAL						$2,560,352
CONTINGENCY (25% of Subtotal)						$640,088
TOTAL						$3,200,440

Additional sampling and characterization of Landfill A must be completed to confirm the effectiveness of a cap. The additional characterization will evaluate the possibility of the presence of dense nonaqueous phase liquids (DNAPLs) and liquid waste in containers buried in the landfill. If containerized wastes are in the landfill, then these may require excavation and treatment or disposal at an approved facility. If there is no containerized waste, soil vapor extraction or a vent in the cap may be warranted, depending on the concentrations of the VOCs in the soil.

Performance Standards

Landfill A Landfill B, and the dry sludge impoundment will be covered with an impermeable cap as specified above. These areas contain soils contaminated with greater than 10 ppm total PCBs, the performance standard at the GE Subsite. At the Shepherd Farm Subsite, surficial soils contaminated with PCBs above the performance standard of 1 ppm total PCBs will be excavated and transported to the dry sludge impoundment area of the GE Subsite. Surficial soils are defined as the zone from the surface to 12 inches below grade. The excavated area will be regraded and backfilled with clean soil. In addition, the areas will be revegetated. Residential yards will be restored as close as possible to their original appearance. Air quality monitoring shall be conducted at the perimeter of the excavation site to ensure that residents are not adversely affected.

Short-term impacts to the Spring Haven community will be kept to a minimum by utilizing Spring Haven drive as little as possible. For health and safety considerations, the residents within the areas of contamination may, at EPA's discretion, be temporarily relocated to avoid injury and/or if utilities are disconnected during the excavation period.

B. Groundwater Remediation

Groundwater remediation will address the contaminated groundwater at the Site. Groundwater remediation will include extraction of contaminated groundwater, treatment, in-situ bioremediation and final discharge to Bat Fork Creek, or the treated water may be used as a source of water in the in-situ treatment of the groundwater. The viability of using the treated water in GE's plant process may also be evaluated.

The ex-situ treatment will consist of air stripping to remove organics, and granulated activated carbon adsorption to treat the vapor effluent, or off-gas to remove the contaminants stripped from the groundwater prior to being discharged to the atmosphere. If metals are detected in the liquid effluent at concentrations above the discharge limitations, a process option to remove metals will be added to this treatment train. In addition, the groundwater may need filtering prior to treatment to remove any particulates that may harm the air stripper. The in-situ treatment will involve the construction of infiltration trenches or injection wells at an appropriate location at both the GE and Shepherd Farm Subsites to introduce microorganisms, nutrients, etc into the aquifer. The ex-situ treatment system will be located on the GE facility, with contaminated groundwater from Shepherd Farm pumped to this location.

The groundwater system will operate 24 hours per day. System controls will allow complete automatic operation with minimal operator attention. Long-term monitoring for cleanup verification purposes and to track contaminant plume migration will be required. The system is expected to operate 15 years; samples will be collected from 20 existing wells on a quarterly basis for the first 5 years, and on an annual basis for the following 10 years. The groundwater system will also require monitoring and maintenance. Monitoring of the treatment system will include periodic sampling of the influent and effluent from the treatment system and analysis in accordance with the surface water discharge requirements.

B.1. Extraction and Performance Standards

Groundwater will be extracted from the GE facility and the Shepherd Farm property. Location and number of extraction wells and pumping rates will be determined during the remedial design. Final discharge will be to Bat Fork Creek. Discharge standards will be driven by the surface water discharge requirements (ARARs, See Section VII) and will be defined during the development of the Remedial Design.

The goal of this remedial action is to restore the groundwater to its beneficial use. Based on information obtained during the RI, and the analysis of all remedial alternatives. EPA and the State of North Carolina believe that the selected remedy will be able to achieve this goal.

Groundwater contamination may be especially persistent in the immediate vicinity of the contaminants' source, where concentrations are relatively high. The ability to achieve remediation levels at all points throughout the area of attainment, or plume, cannot be determined until the extraction system has been implemented, modified, as necessary, and plume response monitored over time.

Groundwater shall be treated until the following performance standards are attained throughout the contaminant plumes:

Contaminant	Remediation Level	Risk Level
Barium	2,000 ug/l	HI = 1
Beryllium	4 ug/l	1E-04
Nickel	100 ug/l	HI = 1
Lead	15 ug/l	NA
Manganese	50 ug/l	HI = 0.6
Vinyl Chloride	1 ug/l	1E-05
1,2-Dichloroethene	70 ug/l	HI = 0.4
Trichloroethene	2.8 ug/l	1E-06
Benzene	1 ug/l	1E-06
Tetrachloroethene	1 ug/l	1E-06
Nitrobenzene	10 ug/l	HI = 1
Chloroform	1 ug/l	HI = 0.1
1,2-Dichloroethane	1 ug/l	1E-06

Hazard Index (HI) - Relates to non-cancer risks
1E-06 Risk Level - Probability for carcinogenic effects
NA - Not applicable. Risk from lead is not calculated using HI or risk level.

If the selected remedy cannot meet the specified performance standards, at any or all of the monitoring points during implementation, the contingency measures and goals described in this section may replace the selected remedy and goals for these portions of the plume. Such contingency measures will, at a minimum, prevent further migration of the plume and include a combination of containment technologies and institutional controls. These measures are considered to be protective of human health and the environment, and are technically practicable under the corresponding circumstances.

The selected remedy will include groundwater extraction for an estimated period of 15 years, during which time the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

a) at individual wells where remediation levels have been attained, pumping may be discontinued;

b) alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater;

d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup continues to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of at least every 2 years following discontinuation of groundwater extraction.

If it is determined on the basis of the preceding criteria and the system performance data, that certain portions of the aquifer cannot be restored to their beneficial use, all of the following measures involving long-term management may occur, for an indefinite period of time, as a modification of the existing system:

a) engineering controls such as physical barriers, or long-term gradient control provided by low level pumping, as contaminant measure;

b) performance standards may be waived for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further contaminant reduction;

c) institutional controls may be provided/maintained to restrict access to those portions of the aquifer which remain above remediation levels;

d) continued monitoring of specified wells; and

e) periodic reevaluation of remedial technologies for groundwater restoration.

The decision to invoke any or all of these measures may be made during a periodic review of the remedial action, which will occur at 5 year intervals in accordance with CERCLA Section 121(c).

The remedial actions shall comply with all ARARs (See Section VII). The applicability of RCRA Land Ban Requirements to the removal of the contaminated soil from the Shepherd Farm Subsite to the GE Subsite was investigated and found not to be applicable. Similarly, the TOSCA regulations were investigation to determine their applicability to capping the dry sludge impoundment area; they were not found to be applicable.

The presence of contamination contained onsite and the presence of contaminants in the groundwater will require deed recordation/restriction to document their presence and could limit future use of the property. The extent of the property restrictions and limitations will be determined during the remedial design.

C. Additional Sampling Requirements

Additional groundwater and soil sampling shall be conducted to further define the extent of contamination. Specifically, the following shall be obtained at a minimum:

- Additional soil samples shall be collected in Landfill A. If sampling results indicate significant VOC contamination, fate and transport analysis of VOC contamination may be warranted. In addition, an evaluation of the likelihood of vapor transport around the cap upward to the atmosphere and vapor transport downward to the groundwater may be needed.

- Additional soil samples shall be collected in the vicinity of monitor wells MW-14 and MW-25. These areas may have undiscovered sources.

- Additional monitor wells shall be placed and sampled: 1) east of Bat Fork Creek between temporary well TW-1 and TW-2; 2) west of Spartanburg Hwy across from MW-25 and MW-26; and 3) north of Tabor Road across from Landspreading Area A. The purpose of these wells is to further define the extent of groundwater contamination.

- Periodic sampling of private wells in the area that are used for drinking water purposes. As part of the Remedial Design, additional sampling of private wells include wells located upgradient of the GE and Shepherd Farm Subsites. These wells will be selected to evaluate the effect of fracture-flow on the groundwater contamination.

- Sampling near monitor well MW-35 to determine if additional source areas are present. Additional groundwater investigation near this well.

- Additional soil samples shall be collected on a 25-foot grid throughout the suspected area of soil contamination at the Shepherd Farm property to determine the aerial extent of surficial PCB contamination and to determine the location of any existing VOC sources. Additional soil samples shall also be collected north and west of locations 53 and 56.

- Additional monitor wells shall be placed and sampled at the Shepherd Farm Subsite to determine the extent of the groundwater contamination.

- Additional fish tissue samples will be collected in Bat Fork Creek and Mud Creek to determine the extent of PCB-contaminated fish.

- Periodic sampling of the surface water and sediments of Bat Fork Creek to determine if the groundwater remediation is having a positive effect on the quality of the creek.

- Monitor well installation to demonstrate that there is no groundwater contamination caused by the dry sludge impoundment area and that the waste is at least four feet above the seasonal high water table.

- Additional soil sampling to confirm the outline of the sludge impoundment contamination.

- Additional sampling and testing to demonstrate that the PCB contaminants are stabilized within the impoundment sludges and will not leach to the environment.

XII. DOCUMENTATION OF SIGNIFICANT CHANGE

CERCLA Section 117(b) requires an explanation of significant change from the preferred alternative presented in the Proposed Plan. In the proposed plan, Alternative SS5 was chosen for GE soils and Alternative SS3 was chosen for the Shepherd Farm soils.

However, comments were received questioning the remedial action on the dry sludge impoundment area on the GE property. GE sampled the dry sludge impoundment in 1991. The results of this sampling investigation are given in Figure 28. Specifically, the dry sludge impoundment is fenced and therefore, direct contact with the soils is prohibited. However, fencing is similar to Alternative 2 - Institutional Controls. The comparative analyses revealed that Alternative 3 - Containment would be best suited for the GE Site. Therefore, to be consistent, the decision was made to include the dry sludge impoundment as an area requiring an impermeable cover.

Consequently, since the dry sludge impoundment has not been found to be a groundwater threat or a surface water run-off threat, Alternative SS3 - Excavation and Off-Site Disposal for the Shepherd Farm Site has been changed to include disposal of the excavated soils at the GE sludge impoundment instead of a RCRA Subtitle D Landfill. This change will result in the same risk reduction at a lower cost.

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If the additional sampling and well installation outlined in Section XI.C shows that a cap will not be effective in containing this contamination, then another remediation technology will be selected to control this source.

In addition, in the proposed plan, it was stated that "Asphalt is considered the most appropriate capping material because portions of the landfills are already paved." Asphalt may be the top layer, however the remedy has been supplemented to include in the cap 18 inches of clay, and a flexible membrane. The cost estimate, however, has not been amended to include the cost of these additional cap layers.

APPENDIX D
STATE CONCURRENCE

State of North Carolina <IMG SRC 0495255A5>
Department of Environment,
Health and Natural Resources
Division of Solid Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
William L. Meyer, Director

September 27, 1995

Ms. Giezelle Bennett
Superfund Branch, Waste Management Division
US EPA Region IV
345 Courtland Street
Atlanta, Georgia 30365

RE: Conditional State Concurrence with the
Record of Decision (ROD)
General Electric/Shepherd Farm
East Flat Rock, Henderson County

Dear Ms. Bennett

The North Carolina Superfund Section has received and reviewed the attached Record of Decision (ROD) for the General Electric/Shepherd Farm Superfund Site and concurs with the selected remedy subject to the following conditions:

1. Our concurrence on this ROD and of the selected remedies for the site is based solely on the information contained in the attached ROD and to the conditions listed here. Should we receive additional information that significantly affects the conclusions or remedies contained in the ROD, we may modify or withdraw this concurrence with written notice to EPA Region IV.

2. Our concurrence on this ROD in no way binds the State to concur in future decisions or commits the State to participate, financially or otherwise, in the cleanup of the Site. The State reserves the right to review, comment, and make independent assessments of all future work relating to this Site.

3. If, after remediation is complete, the total residual risk level 10-6, the State may require deed recordation/restriction to document the presence of residual contamination and possibly limit future use of the property as specified in NCGS 130A-310.8.

We appreciate the opportunity to comment on this ROD and look forward to continuing to work with the EPA to remediate this Site.

Sincerely,
<IMG SRC 0495255A6>

Attachment
cc: Curt Fehn
Mike Kelly
Dave Lown